A COMPARATIVE STUDY OF RIGHT AND LEFT IJV CANNULATION USING SURFACE ANATOMY OR USG GUIDANCE

Thesis submitted to the Tamil Nadu Dr.M.G.R medical university in partial fulfillment of the rules and regulations for MD degree examination in Anaesthesiology to be held in April 2015

DEPARTMENT OF ANAESTHESIOLOGY Dr. ANITHA SUNNY

PSG INSTITUTE OF MEDICAL SCIENCES 2011-2014

& RESEARCH, COIMBATORE

CERTIFICATE

This is to certify that Dr. ANITHA SUNNY a post graduate student (2012-2015) in the Department of Anaesthesiology, PSG Institute of Medical Sciences & Research, Coimbatore has done this dissertation titled **"A COMPARATIVE STUDY OF RIGHT AND LEFT IJV CANNULATION USING SURFACE ANATOMY OR USG GUIDANCE"**under the direct guidance and supervision of guide Prof. Dr. C.Gansean, in partial fulfillment of the regulations laid down by the TamilnaduDr.M.G.R.Medical University, Chennai, for MD, Anaesthesiology degree examination.

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DECLARATION

I hereby declare that this dissertation entitled **"A COMPARATIVE STUDY OF RIGHT AND LEFT IJV CANNULATION USING SURFACE ANATOMY OR USG GUIDANCE"**was prepared by me under the direct guidance and supervision of Prof. Dr. C.Gansean, PSG Hospitals, Coimbatore.

This dissertation is submitted to the Dr.M.G.R. Medical University in partial fulfillment of the university regulations for the award of MD degree in Anaesthesiology, Examination to be held in April 2015.

Place: Coimbatore

Date:

Dr. Anitha Sunny

PSG Institute of Medical Sciences & Research
Institutional Human Ethics Committee

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January 6, 2014

To
Dr Anitha Sunny
Postgraduate
Dept. of Anaesthesiology
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Coimbatore

Ref.: Proposal titled: *"A comparative study of right and left IJV cannulation using surface anatomy or USG guidance"*

Sub.: Ethics Committee Approval for the study

The Institutional Human Ethics Committee, PSG IMS & R, Coimbatore -4, has reviewed your proposal on 3rd December, 2013 in its full board review meeting held at College Council Room, PSG IMS&R, between 2.00 pm and 4.30 pm, and discussed your application to conduct the study entitled:

"A comparative study of right and left IJV cannulation using surface anatomy or USG guidance"

The following documents were received for review:

1. Duly filled application form
2. Proposal
3. Informed Consent forms (Ver 1.1)
4. Data Collection Tool
5. CV
6. Budget

The members who attended the meeting at which your study proposal was discussed are as follows:

Sl. No.	Name of the Member of IHEC	Qualification	Area of Expertise	Gender	Affiliation to the Institution Yes/No	Present at the meeting Yes/No
1	Dr. S. Bhuvaneshwari (Member-Secretary, IHEC)	MD	Clinical Pharmacology	Female	Yes	Yes
2	Mrs. Geetha S Kannan	+ 2	Lay person	Female	No	Yes
3	Mr Gowpathy Velappan	BA., BL	Legal Advisor	Male	No	Yes
4	Mrs G Malarvizhi	M Sc	Nursing	Female	Yes	Yes
5	Mr. R. Nandakumar (Vice-Chairperson, IHEC)	BA., BL	Legal Expert	Male	No	Yes
6	Dr. G. Rajendiran	DM	Clinician (Cardiology)	Male	Yes	No
7	Dr. V. Ramamurthy	Ph D	Biotechnology	Male	Yes	Yes

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9	Dr. P. Sathyan (Chairperson, IHEC)	DO, DNB	Clinician (Opthalmology)	Male	No	Yes
10	Dr. Seetha Panicker	MD	Clinician (Obstetrics & Gyanaecology)	Female	Yes	Yes
11	Dr. S. Shanthakumari	MD	Pathology, Ethicist	Female	Yes	No
12	Dr. Y.S. Sivan	Ph D	Social Scientist (Sociology)	Male	Yes	Yes
13	Dr. Sudha Ramalingam (Alternate Member-Secretary, IHEC)	MD	Public Health, Epidemiology, Genetics, Ethicist	Female	Yes	Yes
14	Mrs. K. Uma Maheswari	M Sc, M Phil. B Ed	Botany	Female	No	No
15	Dr. D. Vijaya	M Sc, Ph D	Basic Medical Sciences (Biochemistry)	Female	Yes	Yes

After due consideration, the committee has decided to approve the above proposal.

The approval is valid for one year.

We request you to intimate the date of initiation of the study to IHEC, PSG IMS&R and also, after completion of the project, please submit completion report to IHEC.

We hereby confirm that neither you nor any of your study team members have participated in the voting/ decision making procedure of the committee. The members of the committee who have participated in the voting/ decision making procedure of the committee do not have any conflict of interest in the referenced study.

This Ethics Committee is organized and operates according to Good Clinical Practice and Schedule Y requirements.

Non-adherence to the Standard Operating Procedures (SOP) of the Institutional Human Ethics Committee (IHEC) and national and international ethical guidelines shall result in withdrawal of approval (suspension or termination of the study). SOP will be revised from time to time and revisions are applicable prospectively to ongoing studies approved prior to such revisions.

PIs are required to send progress reports (in the form of an extended abstract with publications if any) to the IHEC every six months (and a month before expiry of approval date, if renewal of approval is being sought).

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Dr S Bhuvaneshwari
Member - Secretary
Institutional Human Ethics Committee

SECRETARY
PSG IMS & R
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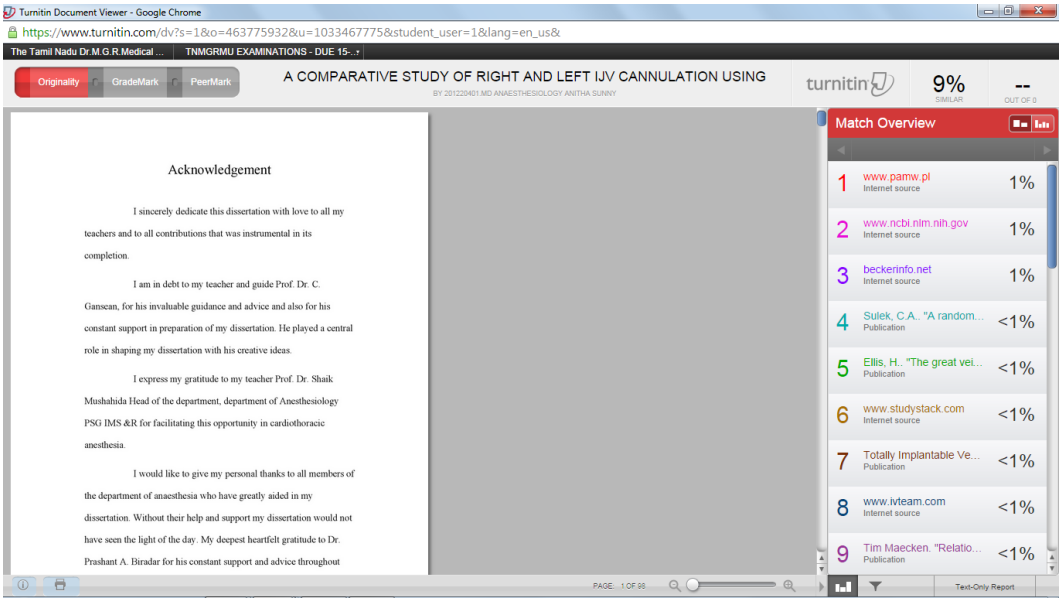
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Acknowledgement
I sincerely dedicate this dissertation with love to all my teachers and to all contributions that was instrumental in its completion.
I am in debt to my teacher and guide Prof. Dr. C. Gansean, for his invaluable guidance and advice and also for his constant support in preparation of my dissertation. He played a central role in shaping my dissertation with his creative ideas.
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Acknowledgement

I sincerely dedicate this dissertation with love to all my teachers and to all contributions that was instrumental in its completion.

I am in debt to my teacher and guide Prof. Dr. C. Gansean, for his invaluable guidance and advice and also for his constant supportin preparation of my dissertation. He played a central role in shaping my dissertation with his creative ideas.

I express my gratitude to my teacher Prof. Dr. ShaikMushahida Head of the department, department of Anesthesiology PSG IMS &R for facilitating this opportunity in cardiothoracic anesthesia.

I would like to give my personal thanks to all members of the department of anaesthesia who have greatly aided in my dissertation. Without their help and support my dissertation would not have seen the light of the day.My deepest heartfelt gratitude to Dr. Prashant A. Biradar for his constant support and advice throughout my study period. My special thanks to

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TABLE OF CONTENTS

Abstract

Background- Internal jugular vein cannulation (IJV) is a routinely done procedure in indicated patients. This procedure has been associated with many complications. We have assessed the utility of ultrasound in our hospital setup.

Aims and objectives- To compare the success rate in right and left internal jugular vein cannulation using surface anatomy or ultrasound guidance. The time taken from initial puncture to successful insertion of guidewire was compared. The number of attempts and incidence of complications were also compared.

Study design- A prospective randomized study in 106 patients from all patients indicated for internal jugular vein cannulation during the study period.

Methods and materials- After approval from the ethics committee, consent was obtained for the study. 106 patients were randomly assigned into 4 groups- Group 1 right IJV cannulation using surface anatomy, Group 2- right IJV cannulation using USG guidance, Group 3 left IJV cannulation using surface anatomy, Group 4- left IJV cannulation using USG guidance. Data on time taken, number of attempts and incidence of associated complications was taken.

Results- The mean time taken in group 1, group 2, group 3 and group 4 were 172.45±213.60, 136.47±122.86 seconds, 273.87±127.59 seconds, and 135.25±105.09 seconds respectively. There was no statistically significance between Group 1 and Group 2 (p value >0.05) and between Group 2 and Group 4(p value >0.05). There was a statistically significant difference (p value <0.001) between Group 3 and Group 4.The average attempts in group 1, group 2, group 3 and group 4 were 2.05± 1.22, 1.46± 0.64, 2.78±1.41, and 1.69±0.18 respectively. There was a difference in number of attempts between Group 1 and Group 2 and between Group 3 and Group 4that was statistically significant (p value <0.05, p value <0.01, respectively). But there was no statistically significance between Group 2 and Group 4(p value>0.05).Statistic evaluation of the incidences of carotid puncture shows no statistically significance between Group 1 (5.3%) and Group 2(nil) (p value>0.05) but there was statistical significance between Group 3(34.8%) and Group 4(nil) (p value <0.01)

Conclusion- Ultrasound helps in safer successful cannulation of the internal jugular vein with lesser incidence of complications of carotid punctures especially for left sided internal jugular vein cannulations. Moreover, ultrasound guided internal jugular vein cannulation helps in reducing the average time duration

1. Introduction

In this twenty-first century, there are major advancements and evolvements in technology, medicine and health care. Latest techniques for safer medical practices are being explored and developed. Recent emphasis is on patient safety and prevention of iatrogenic complications [(1)].

As internal jugular cannulation is indicated for patients who are in need of central venous access, various safer and better approaches are explored. As anesthesiologists, we are needed for cannulation of internal jugular vein based on landmarks and surface anatomy. In critical care areas and formajor surgeries, internal jugular vein cannulation is needed for monitoring apart from other purposes for example- inotropic supports, total parental nutrition, administration of chemotherapeutic medications, central venous oxygen saturation, etc.[(2)].

Conventionally the internal jugular vein was cannulated by identification of external surface landmarks and puncturing on the anticipated course of the internal jugular vein [3]. By use of landmarks, this central venous access was obtained by probability of success. But this method has been associated with various difficulties such as anatomical variations, neck deformities, previous cannulation, etc. By use of landmark method has often led to inadvertent complications. More so has also led to many major risks especially in patients having associated coagulopathy [2].

Surface landmark technique of internal jugular cannulation has been associated with 60% to 90% success rate based on cannulation site and patient population. With usage of the surface anatomy methods for cannulation of internal jugular vein, there are more incidences of complications. This leads to multiple attempts and longer time to cannulate the vein. And this in turn causes patients to be non-cooperative.

Various techniques, positions and approaches were attempted for internal jugular cannulations. One such approach suggested is the ultrasound guided approach for vascular access. By this method, the vessels are cannulated with its relationships to surrounding landmarks. Hence real time two dimensional ultrasound imaging of internal jugular allows lesser possibilities for complications with better patient compliance during internal jugular venous catheter insertion. Complications such as carotid puncture, pneumothorax, hemothorax and nerve injury can be prevented

1.1. Indications for internal jugular catheterization [11]

- Hemodynamic monitoring
- Rapid intravenous fluid administration
- Parenteral nutrition
- Temporary hemodialysis
- Intravenous medications such as antibiotics, inotropes, etc.
- Percutaneous pacemaker
- Access for pulmonary artery catheters

- Air embolism during procedure
- Intravenous access when peripheral venous access is not possible
- Multilumen intravenous access when needed

1.2. Contraindications of internal jugular catheterization [11]

There are no absolute contraindications for internal jugular cannulations except in superior vena cava syndrome but there are relative contraindications. The relative contraindications are-

- Mechanical difficulty in obtaining access to neck such as local site skin infections, abscess, burns, mass or swellings, scars, trauma or contractures
- Coagulopathy- can lead to formation of hematomas but since internal jugular vein can easily be compressed it is usually preferred site for central venous catheterizations
- Spine deformity or impairment of neck movements; position for cannulation may be inadequate
- Anomalous variations

- ❖ Thrombosis
- ❖ Psychiatric disorders
- ❖ Patient cooperation to remain still so that risk of injury to surrounding structures are minimized

1.3. Complications of internal jugular catheterization [11]

- ➢ Carotid artery punctures
- ➢ Hematomas
- ➢ Pericardial perforation – cardiac tamponade
- ➢ Pneumothorax
- ➢ Hemothorax
- ➢ Catheter related infections
- ➢ Brachial plexus injury
- ➢ Catheter related venous thrombosis

Since the introduction of ultrasound into clinical practice in the late 1970s, various applications of ultrasound were explored. Improvements in making ultrasound a bedside tool were made by

reducing the bulky ultrasound machines into affordable, handy portable devices with simplified computer software technology that has high resolution to differentiate tissues and blood flow.

Unfortunately, the use of this technology has been limited mainly due to machine cost. Other reasons are being due to lack of training in proper use of ultrasound machine and probe manipulations, control of image optimization, and vessel identification. However, this technique helps in cannulating the central veins more safely with minimum non-compliance made by patients especially in an experienced hand.

Studies have been done to assess reasons for failure of surface anatomy guided internal jugular cannulations. These studies show that one reason for failure is the presence of anatomical variants. The internal jugular vein commonly lays anterolateral to the common carotid artery at the cricoid level. The internal jugular vein lies medial, posterior or far lateral in relation to common carotid artery in some individuals [4, 5].

Our study focuses on the application of ultrasound guided internal jugular cannulation approach in routine anesthesia practice. And assess its utility in presence of traditional hospital methods.

Our study aims for safer successful internal jugular vein cannulations with minimal complications and fewer attempts in all patients requiring internal jugular catheterization. So we would like to compare the application of ultrasound with surface anatomy for internal jugular vein cannulation

AIMS AND OBJECTIVES OF THE STUDY

2. Aims and Objectives

Primary objectives

- To compare the success rate for the right and left internal jugular venous cannulation by using surface anatomy or ultrasonography guidance.
- To compare the time taken by right and left internal jugular venous cannulation by using surface anatomy or ultrasonography guidance.

Secondary objectives

- To compare the number of attempts for the right and left internal jugular cannulations by using surface anatomy or ultrasound guidance
- To compare the incidence of complications in right and left internal jugular cannulations by using surface anatomy or ultrasound guidance

REVIEW OF LITERATURE

3. Anatomy

3.1. Anatomy of internal jugular vein

Cannulation of the internal jugular vein in indicated patients is an important aspect in patient care management for hemodynamic monitoring and for fluids and medication administration. Moreover, for internal jugular cannulations anesthesiologists should have prior detailed knowledge of the anatomy of the internal jugular veins and its relationship to the surrounding great vessels.Normal variations and abnormalities in the venous drainage system may present as a challenge to many anesthesiologists. An illustrated review of the anatomy can help.

3.1.1. Histological features of the vein wall

The walls of the vessels are made of three tissue layers – the inner endothelial layer (tunica initma), the middle muscular layer (tunica muscularis) and the outer connective tissue layer (tunica

adventitia). These three layers vary in relative thickness. When histology of the vein is compared with artery, it has been noted that the outer layer is thicker than the inner two layers. Due to this, the venous system is more compliant and distensible and therefore acts as a reservoir. The veins are thin walled and contain valves that willonly allow unidirectional of blood flow in the veins. These characteristicsof the veins help in differentiating the internal jugular vein from the common carotid artery under ultrasound guidance. The internal jugular veins are easily compressible with the ultrasound probe during detection when compared to the common carotid artery. Unlike arteries the internal jugular veins are not pulsatile. The internal jugular vein tends to distend with increased intravascular volume or by maneuvers, example Valsalvamaneuver, head-down position or pressure over right hypochrondrium, which will increase the venous return to the heart.

For internal jugular vein cannulations, anatomy of the great vessels of the neck and its relations to each other is essential. Major veins of the neck are-

External jugular vein,

Anterior jugular vein,

Internal jugular vein and

Vertebral vein.

3.1.2. Anatomy of the internal jugular vein

Internal jugular vein is the largest vein in the neck. The right internal jugular vein being slightly shorter and bigger when compared to left internal jugular vein. This is because the right internal jugular vein predominately drains the superior saggital sinus and superior petrosal sinus in most individuals. The sigmoid sinus continues as internal jugular vein after the sigmoid sinus has exited through the jugular foramen. The jugular foramen is present at base of the posterior one-third of skull. The internal jugular vein drains blood from the interior of the skull and from face and neck.

The internal jugular vein is dilated at the origin of its course in the jugular fossa to form the superior bulb. The jugular fossa lies below the posterior part of the tympanic floor. At the termination of its course there is an inferior bulb containing two to three valves.

The internal jugular veins descend in the carotid sheath and join the subclavian vein to form the brachiocephalic or innominate vein.

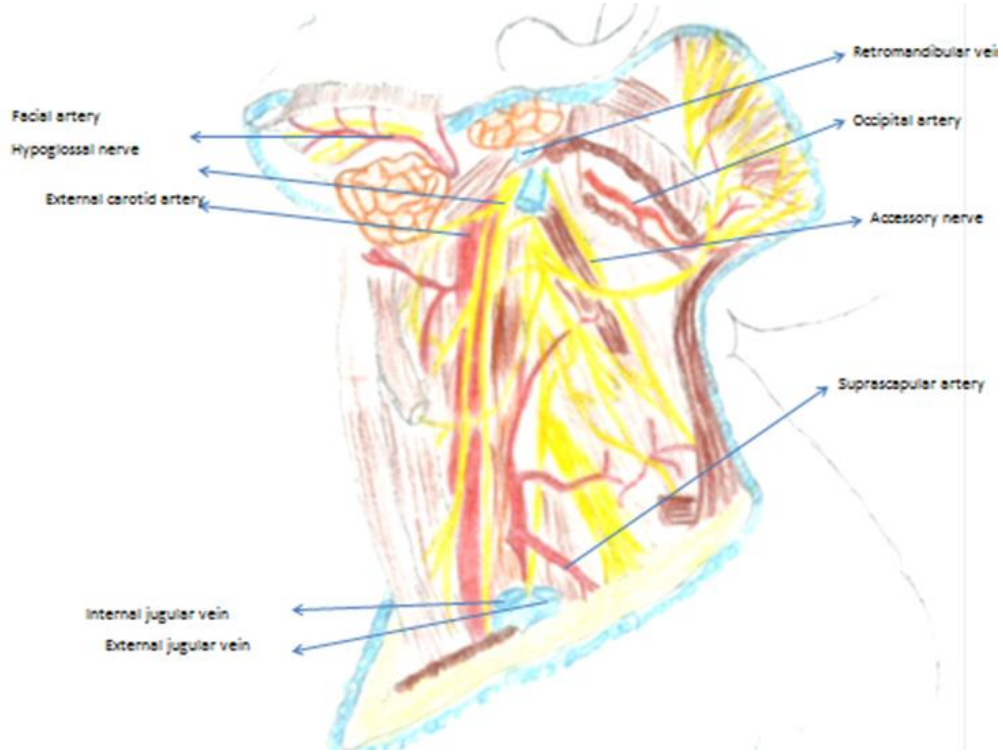


Fig. 1- Left lateral view of the neck depicting the vessels and nerves of the neck

3.1.3. Anatomical relationship of internal jugular vein

The internal jugular vein is medially related to-

- Initially with internal carotid artery then common carotid artery within the carotid sheath.
- The X, XI and IX cranial nerves lies posterior between the common carotid artery and internal jugular vein. The vagus lies within the carotid sheath.
- Vertebral artery and cervical transverse processes.

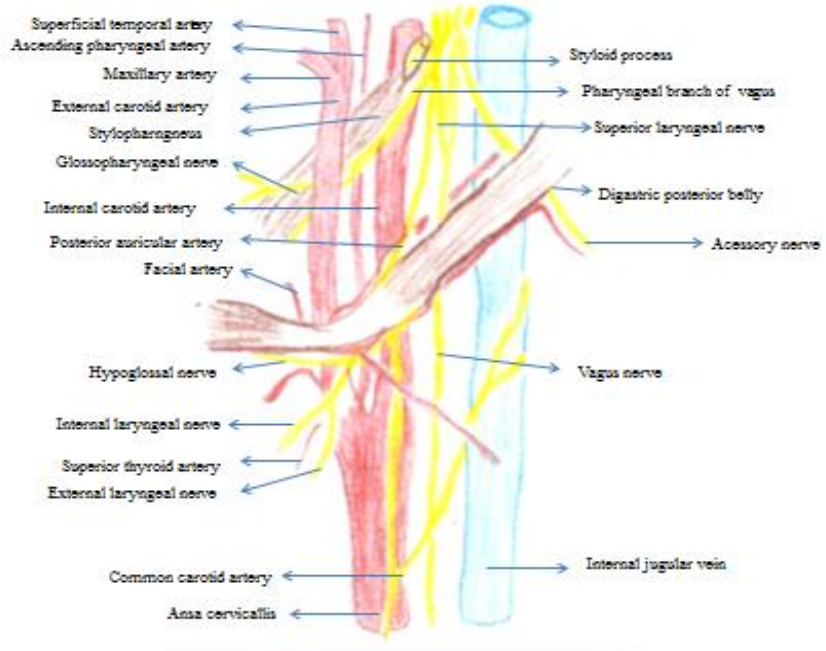


Fig. 2 – The relationship of left internal jugular vein with the left common carotid artery

The internal jugular vein is posteriorly related to-

- Scalens anterior muscle with phrenic nerve on it.
- Roots of the cervical plexus.
- Rectus capitislateralis

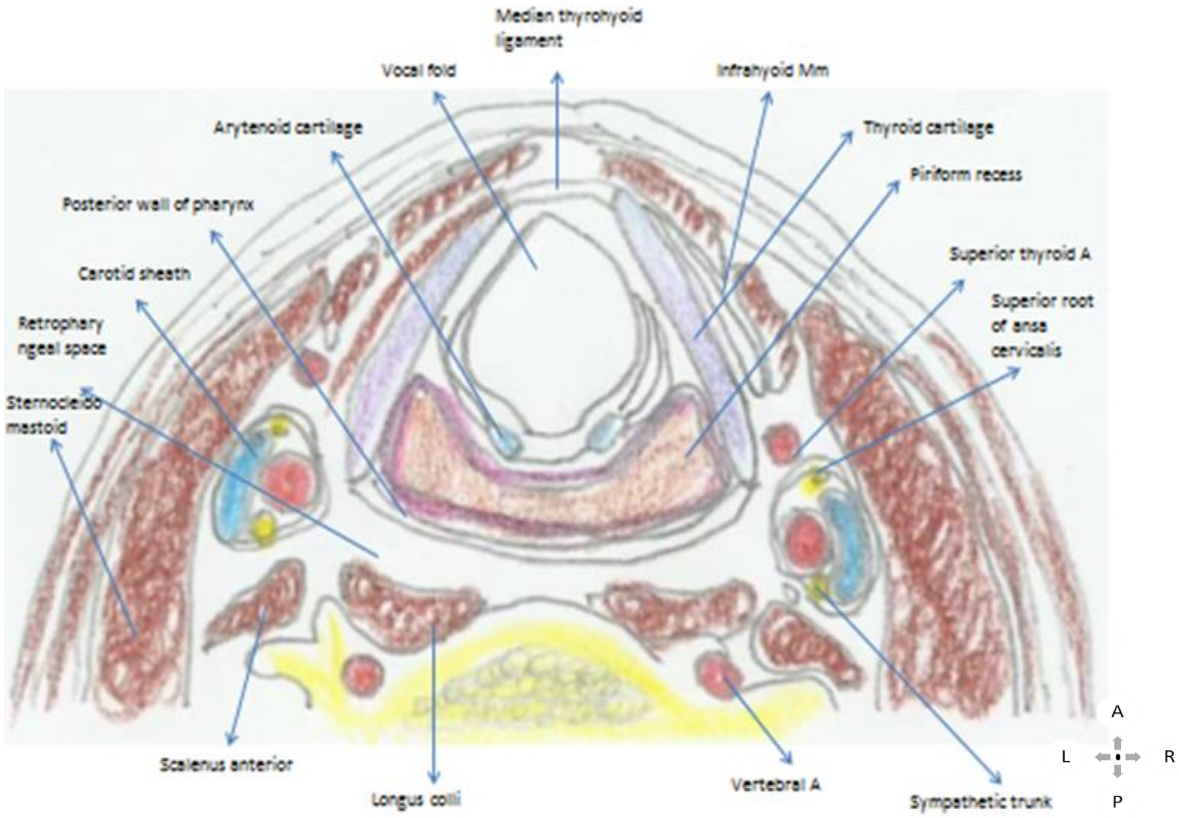


Fig. 3 – The transverse section of the neck at the vocal cord level

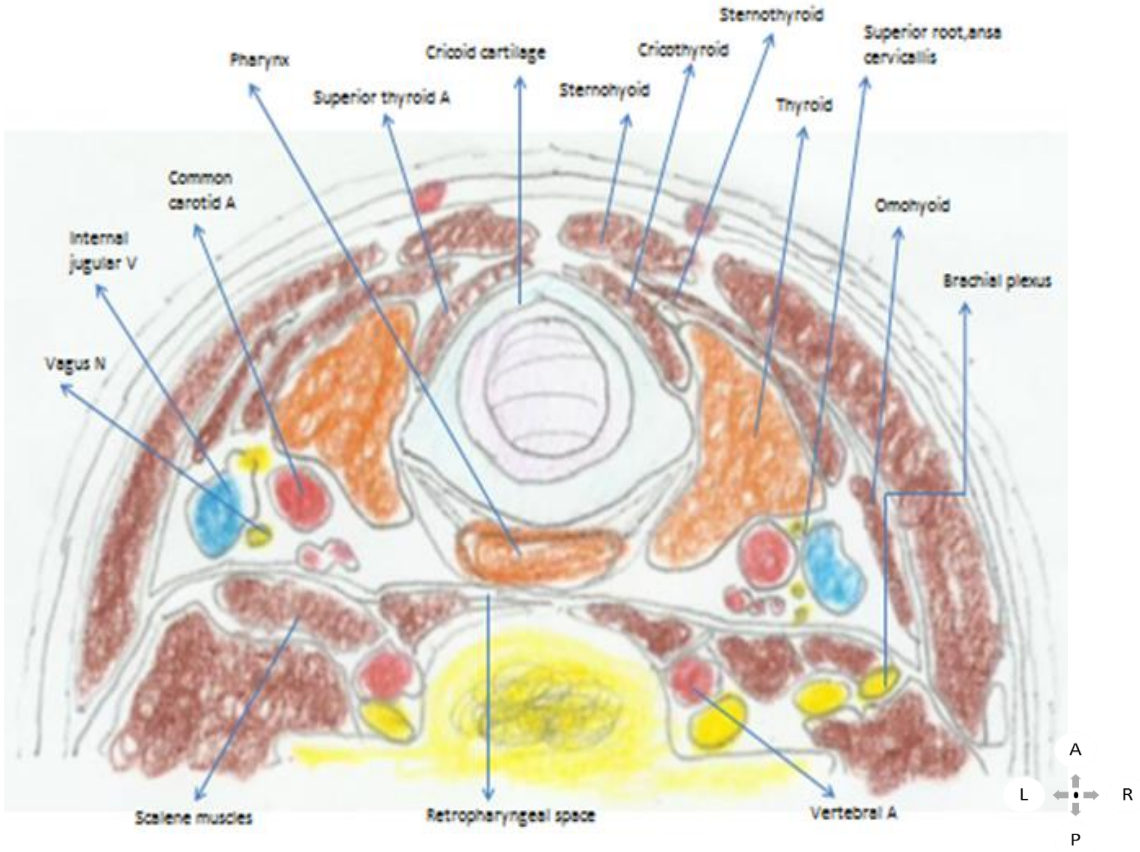


Fig. 4–Transverse section of the neck at cricoid cartilage level

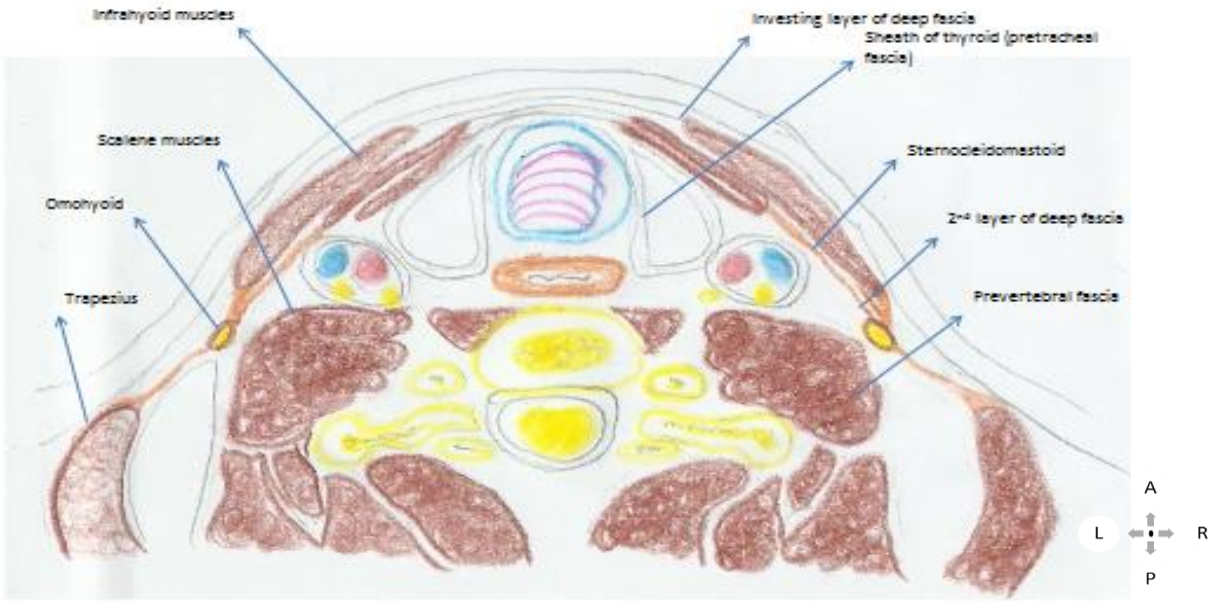


Fig. 5- Transverse section of the neck below the cricoid cartilage

The internal jugular vein is laterally related to-

- Spinal accessory nerve lie behind or in front of the vein

Thoracic duct drains at the junction of the left subclavian vein and the left internal jugular vein. The right lymphatic duct drains between right subclavian and right internal jugular vein. But the drainage of lymph may vary in some individuals.

3.1.4. Tributaries of the internal jugular vein

1. inferior petrosal sinus
2. pharyngeal plexus
3. facial vein
4. lingual vein
5. superior thyroid vein
6. middle thyroid vein
7. occipital vein occasionally if it does not drain into external jugular vein

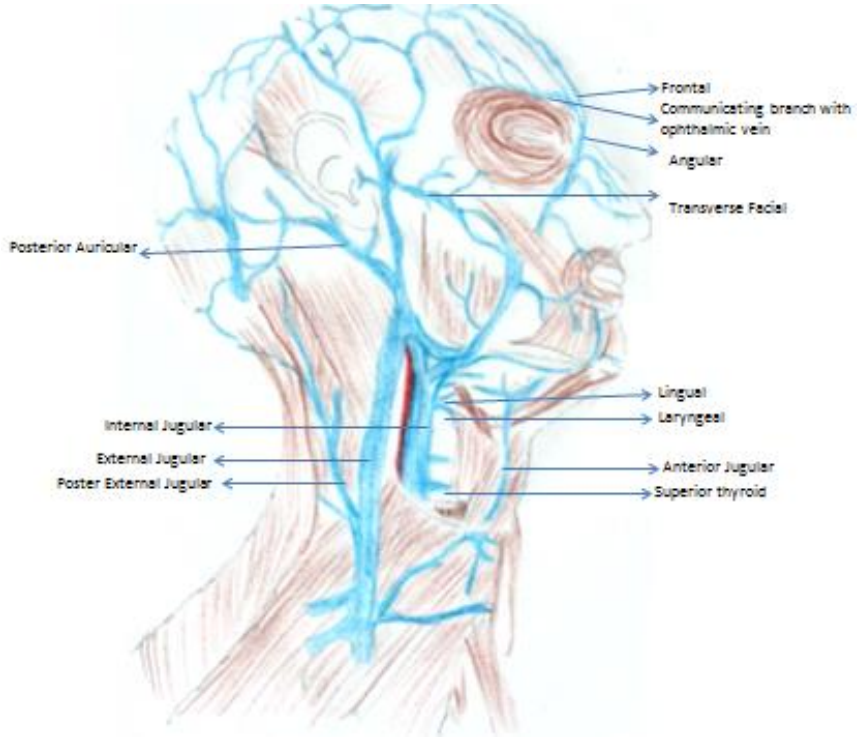


Fig. 6 – The right sided veins and its tributaries of the head and neck

3.1.5. Anatomy of the brachiocephalic veins

The brachiocephalic veins or innominate veins are two trunks formed by the union of the internal jugular vein and subclavian vein which lies between the cervical pleura and medial end of clavicle and later form the superior vena cava. Together they drain the venous blood from the head, neck, upper limbs and wall of thorax. The

brachiocephalic veins then drain into the superior vena cava which lies behind the first costal cartilage at the margin of the right side of sternum. The brachiocephalic veins do not contain any valves.

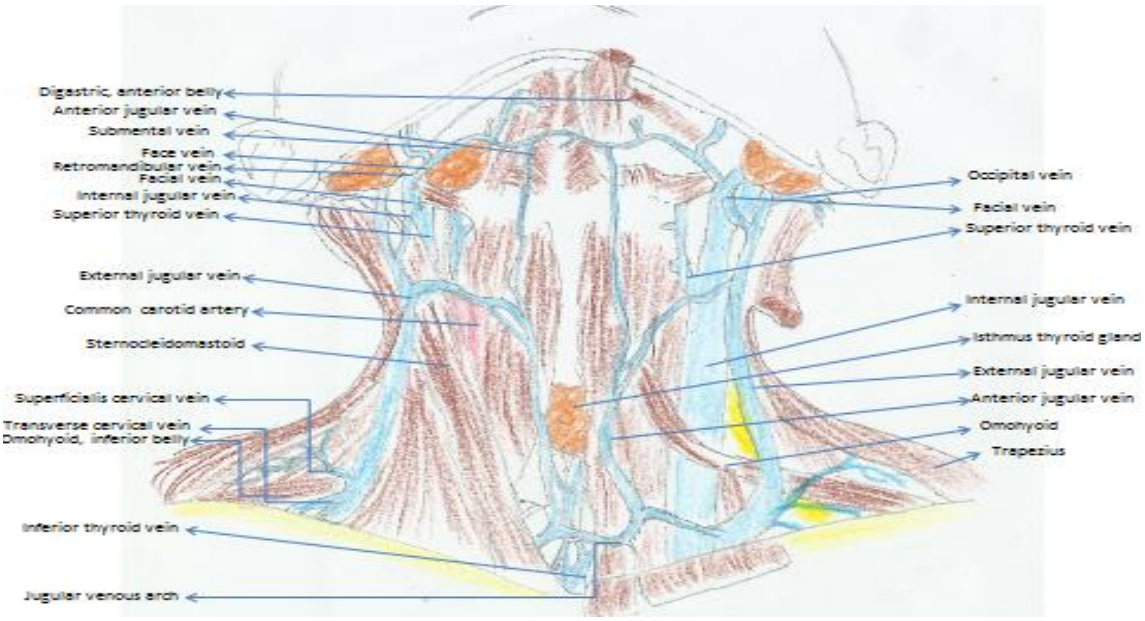


Fig. 7 – The anterior section of the neck depicting the anterior veins of the neck

The right brachiocephalic vein descends into the thorax almost vertically till it joins the left trunk. Theright brachiocephalic vein lays anterolateral to brachiocephalic and right internal thoracic artery, vagus and phrenic nerve, and right cervical pleura. The left brachiocephalic vein descends at an angle into the thorax till it joins the right brachiocephalic vein. The left brachiocephalic vein lies

posterior to the sternoclavicular joint, sternohyoid and sternothyroid muscles and thymus. The left brachiocephalic vein lies anterior to left internal thoracic artery, left vagus and phrenic nerve, trachea and right pleura. The length of the rightbrachiocephalic vein is ~2.5cm whereas the length of the left brachiocephalic vein is ~ 6cm.

Thebrachiocephalic vein receives tributaries from vertebral veins, inferior thyroid veins, superior intercostal vein and sometimes pericardial veins.

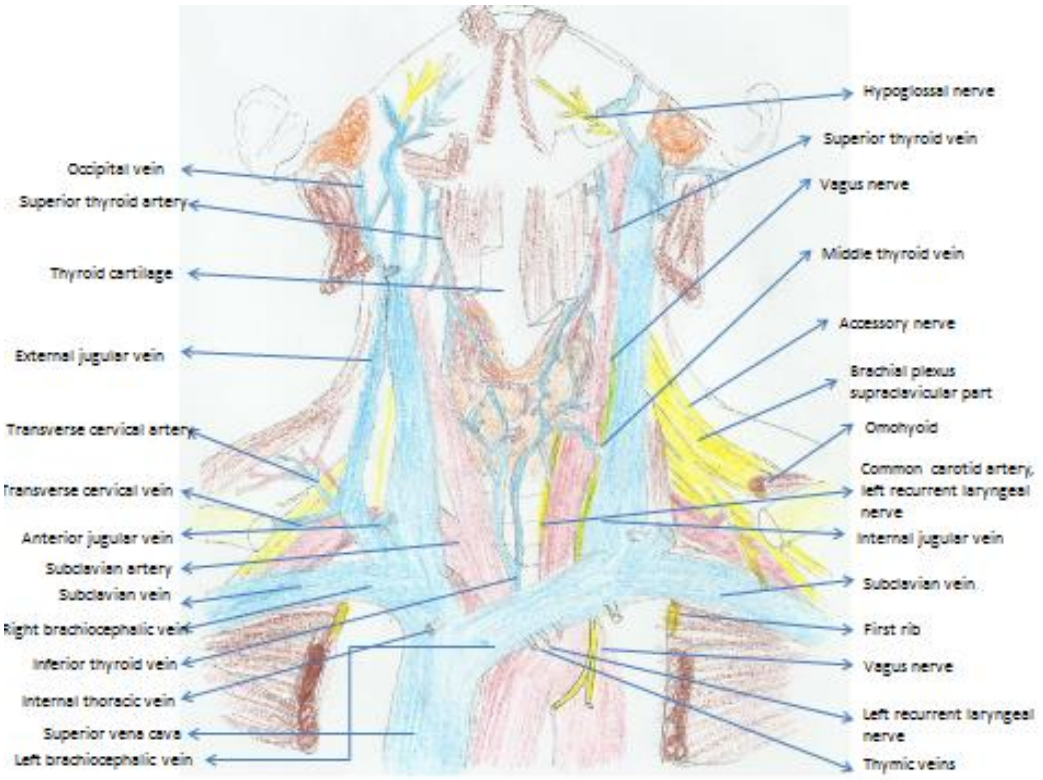


Fig. 8 – The anterior vessels of the neck deeper to the sternocleidomastoid muscles

3.1.6. Anatomy of the superior vena cava

The union of both brachiocephalic veins forms the superior vena cava which then drains into the right atrium. The surface landmarks for marking the extent of superior vena cava are- from the first right costal cartilage near the sternum to a point 3cm below the carina.

Fig. 9 –The formation of brachiocephalic and superior vena cava

It lays anterolateral to trachea and right lung root and posterolateral to ascending aorta partly within the superior and middle

mediastinum. Due to its close relation to the root of the right lung, an anomalous pulmonary vein may drain into the superior vena cava. Its length has been measured to be ~7cm in length. The superior vena cava has no valves throughout its length.

The ideal placement of the catheter tip has been accepted to be either in the superior just outside the pericardial sac at least 3-5 cm from the caval-atrial junction. On a chest X-ray film, this caval-atrial junction lies ~3cm below the carina. Thus, the catheter tip should be seen just below the carina and above the cardiac shadow.

3.1.7. Surface anatomy marking of internal jugular vein

The surface landmarks for marking the internal jugular vein are- from a point on the ear lobule to a point on the medial end of the clavicle. This surface anatomy helps in identifying the anticipated course of the internal jugular vein [(9)].

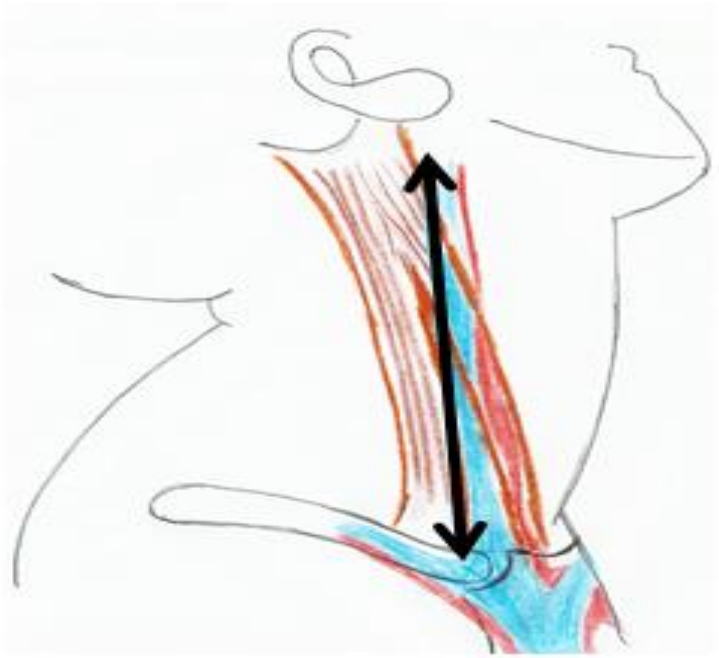


Fig. 10 - Surface anatomy of internal jugular vein

For central venous catheter placement, internal jugular vein is identified between the two heads of sternocleidomastoid muscle and above the clavicle. The internal jugular vein is also identified by visible pulsation that varies with respiration when the patient lies in 45^{o} upright position. This method of identification is used for clinical assessment of jugular venous pressure (JVP) which is a non-invasive indirect measurement of right atrium pressure.

3.1.8. Anatomical variance

Though anatomy of the internal jugular vein is known, studies have demonstrated that there are anatomical variations in the relationship of internal jugular vein with common carotid artery.

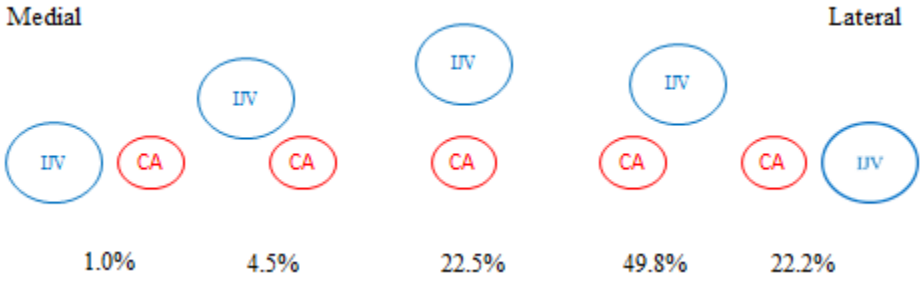


Fig. 10 - The anatomical relationship of right internal jugular vein to right carotid artery

Literature shows that the internal jugular vein lies anterolateral in most individuals (49.8%). In others the internal jugular vein lays medial (1%), or anteromedial (4.5%) or lateral (22.2%). The internal jugular vein is seen overlapping the carotid artery in 22.5%.

Due to its close relationship to the common carotid artery, carotid punctures occur very frequently.

3.2. Principles of Ultrasound[12, 13]

3.2.1. Introduction

In the last two decades, ultrasound has been recommended in various applications. This is because ultrasound is non-invasive, portable and safe even during pregnancy. Unfortunately, use of this technology is limited by cost, need for extra hands, need for extra training and technical know-how of the ultrasound machine. One way to use this modern technology is by understanding the physics behind ultrasound.

3.2.2. Understanding of ultrasound

Ultrasoundwaves are nothing but sound waves that are beyond the human audible range (20Hz – 20,000 Hz). The sound waves are propagation of energy that mechanically oscillates at a certain rate. The time taken to produce an oscillation is based on

frequency. Frequency is equal to number of oscillations or cycles per seconds and is represented as hertz (Hz).

$$\nu = 1 \text{ cycles/sec} = 1 \text{ hertz (1 Hz)}$$

Ultrasonic waves are generated at frequencies greater than 20,000 Hz. Based on the principle that when ultrasound energy is applied, the surrounding particles vibrate. These surrounding particles vibrate adjacent particles in a periodic manner. This vibration is known as compression and rarefaction in ultrasonography.

These waves may be divided into longitudinal waves and transverse waves. Ultrasound waves are longitudinal waves. As the waves travel, the distance between two peaks is known as wavelength. It is represented by the Greek letter ‘λ’, lamda. It indicates the distance during a cycle, the frequency of the transducer and velocity of sound.

$$\nu = \frac{c}{\lambda}$$

Where, ν is the frequency, c is the velocity of sound and λ is the wavelength of sound.

Sound is measured in decibels unit (dB). It is used by sonographers to compare 2 signals.

3.2.3. Piezoelectric effect

Jacques Currie and Pierre Currie discovered the piezoelectric effect. They noticed that when there is a potential difference between the two surfaces of a crystal such as quartz, tourmaline, topaz, etc. there is a conversion of energy. These crystals convert mechanical energy to electric energy. Such materials are called transducers. In ultrasound probes, it contains transducers which convert electric energy into mechanical energy (reverse piezoelectric effect). The transducer generates ultrasound waves by vibration when an alternating current passes through it.

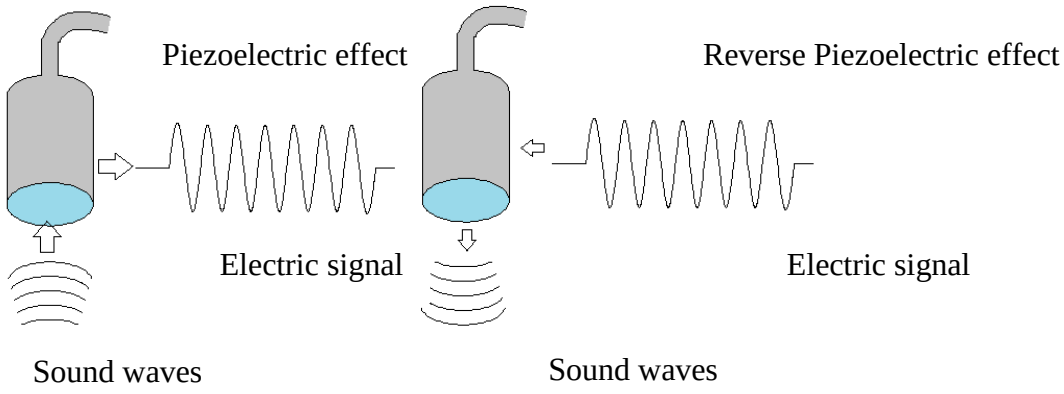


Fig. 11- Piezoelectric effect

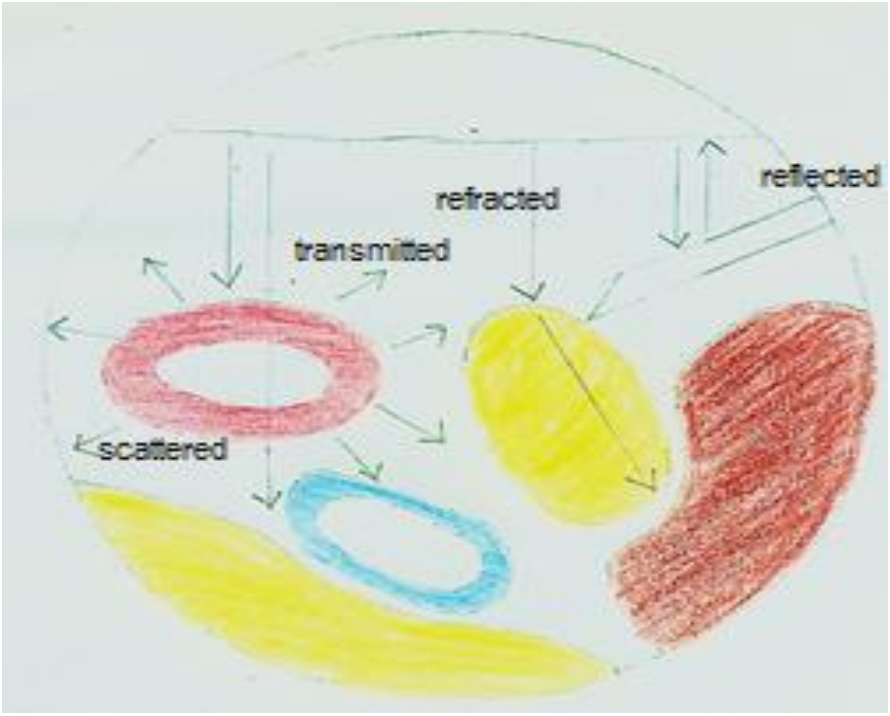


Fig. 12- Propagation of waves through tissues

These waves create an image when placed in contact to a body surface by being reflected, refracted, transmitted and scattered

that can be picked up by the transducer in a receive mode. This depends on the velocity of sound which is determined by the density and elastic properties of the tissue.

The sound waves may get attenuated due to energy lost after absorption, refraction and scattering effect. Hence hyperechoic effects indicate greater degree of reflection and intensities whereas hypoechoiceffects lesser degree of reflection and intensities. So tissues such as bone is seen hypoechoic whereas air filled spaces appear hyperechoic.

3.2.4. Some Characteristics of Ultrasound

Resolution-

It is the ability to differentiate two objects of interest seen together separately i.e. the minimal distance between two objects. It may be axial resolution when the objects lie along the axis of the beam or longitudinal resolution when the objects lie perpendicular to the axis of the beam.

Gain-

It is present in the transducer to amplify or boost echo signals. But too high amplification leads to artifacts to be present.

3.2.5. Different transducer probes

As ultrasound is used in various clinical purposes, for better visualization of the object of interest, different transducer array head scans are present. This allows specific adjustments to frequency.

Different types are-

- Curvilinear array- preferred for abdominal scans
- Linear array- preferred for vascular access, regional anesthesia
- Annular array- for Doppler study
- Sector phase array- preferred for echocardiographs
- Transrectal, transvaginal, transesopheal transducers are special probes to visualize nearest structures.

3.2.6. Different display modes

A-mode (amplitude modulation) - It shows images in one dimension with varying amplitude of the waves.

B-mode (brightness modulation) – It shows images in varying brightness. The images are scan in various directions and then constructed as a single frame for each image.

M-mode (motion modulation) – It displays time and depth along horizontal and vertical axis to visualize movements e.g. heart.

Real time – It is used for dynamic visualization by depicting many image frame/second. Used mainly during procedures.

3.2.7. Limitations

Artifacts are ultrasound echoes that does not relate to the object of interest which is visualized. They can be divided into 4 kinds:-

1. equipment related

2. technique dependent
3. movement related
4. related to tissue impedance

3.2.8. Approaches

Two approaches are typical described. The transverse (short axis) and longitudinal (long axis) view. The transverse view shows all the relation of the structures mediolateral to the internal jugular vein. This view is often used in real time ultrasound approach to cannulate the vein. The long axis view is used in cannulating the internal jugular vein. There is direct visualization of the needle into the vein. To cannulate the vein, the visualized needle is used in either of the two techniques – in plane or out of plane.

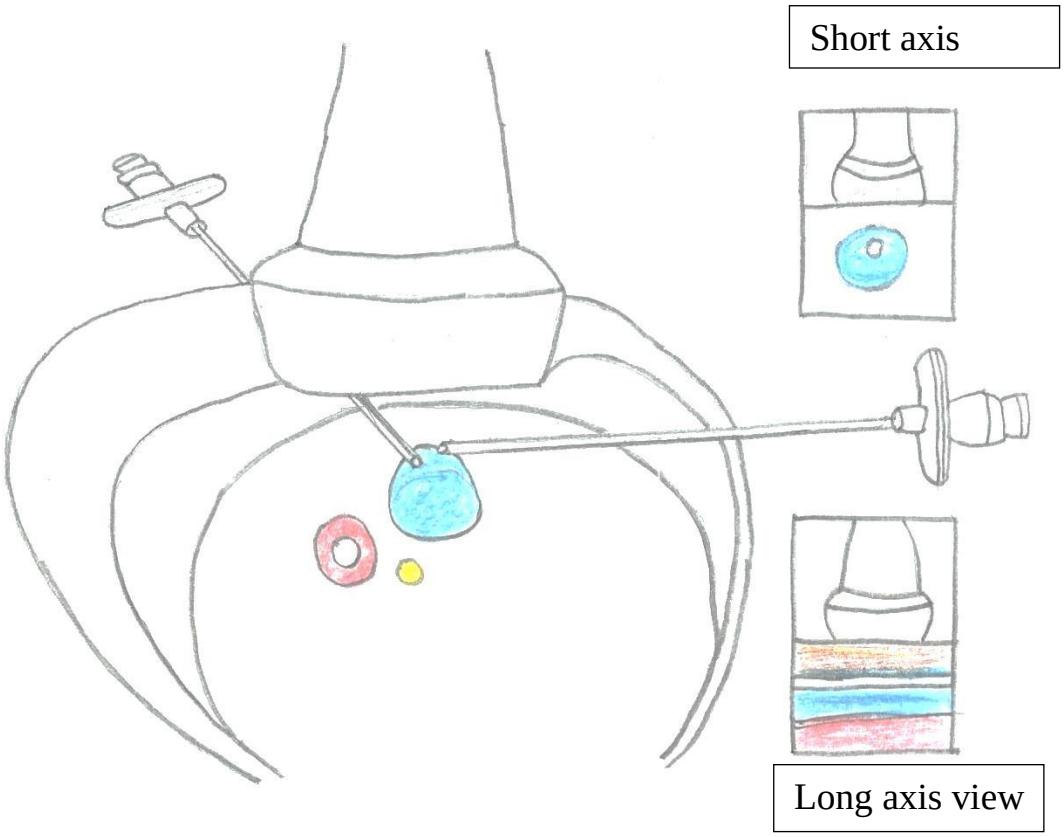


Fig. 13 – Approaches to access the target of interest – short axis view and long axis view

3.2.9 Equipment required for IJV cannulations

Apart from assessing area for cannulation, blood investigations for quantitative and qualitative platelet function assessment should be preferential done in all patients.

An assemble containing all the necessary equipment that are needed. The equipment that is present in our institute are-:

- Local anesthetics – 2% lignocaine
- needles and syringes
- Long 22 or 23 gauge locater needle
- 16 gauge introducer needle
- J-tipped guidewire
- Dilator
- Central line catheter
- Scalpel with blade size 11
- Suture – Vicryl 2-0 with cutting needle
- Antiseptic solutions- povidone-iodine (Betadine) and chlorhexidine (AHD)
- Gauze pads

- Povidone-iodine ointment
- Sterile drapes, gown, gloves and non-sterile surgical cap and face mask
- Tight occlusive dressing – (Tegaderm) with date and time tag

Essential monitors such as pulse oximeter, ECG, non-invasive or invasive blood pressure and/or respiratory monitors should be placed prior to procedure.

An alternate intravenous access should be established if possible prior to procedure. Oxygen supplementation should be given based on individual requirements

3.3 Review of Literature

Cheri A Sulek et al[14] did a randomized study of left versus right internal jugular vein cannulation in 120 adult patients to compare the rate of successful cannulations and the incidence of complications using external landmarks and surface ultrasound guided methods in those patients where central venous cannulation was clinically indicated.

They concluded that the study demonstrates the cannulation of the left IJV takes longer time (247± 176) with more attempts when compared to right IJV (137± 139). The left IJV is associated with increased incidence of complications and failure (between 5% and 10%). The authors concluded that the use of USG significantly increases rate of successful cannulations.

DimitriosKarakitisos et al[2] did a randomized prospective comparison of real-time ultrasound-guided catheterization of the internal jugular vein with landmark technique in 900 patients in critical care to evaluate the superiority of ultrasound guided cannulation method over the standard landmark method. They concluded that the average access time(17.1± 16.5), number of attempts(1.1± 0.6) and complication incidence (was negligible) were reduced in the ultrasound group when compared to the landmark group. Hence they suggested that critical ill patients benefits by the precision placement of catheter by the ultrasound method.

GurkanTirrker et al[15] compared the landmark guided technique versus ultrasound guided technique for IJV cannulation in 380 spontaneously breathing patients and found-though the incidences of complications (1.57±0.14) and access time (95±136) is lower in ultrasound group, the success rate was found to be comparable in both groups(99.47% in ultrasound group versus 97.36% in landmark group).

Serafimids et al[16] compare the classical anatomic landmark technique with ultrasound-guided catheterization of internal jugular vein in 551 oncological patients and found that as ultrasound guided method is faster, more efficient and less morbid procedure. Therefore, it should be the preferred method especially in high risk patients at risk for development of complications such as bleeding.

AnkitAgarwal et al[17] considered using ultrasonography in central venous cannulation as a newer approach to conventional methods in 80 patients. Hereported a mean time of 145 seconds and an average of 1.2 attempts per cannulation with usage of ultrasound when compared to traditionally methods that has taken a mean time of 176.43 seconds and an average 1.53 attempts per cannulation. He compares the uses of ultrasound in internal jugular cannulation with uses of seatbelt while driving a car. He concluded that though ultrasound is a costly investment in developing countries like India, USG guided central venous access is easier, quicker and safer than landmark approach.

As a part of SOAP-3 trial, Milling et al[18] reported that 'a "quick look" with ultrasound' was found to be not advantageous. From their report, they deduced the superiority of ultrasound over landmark technique though an initial training period may be required. Use of static ultrasound before procedure was found to be not useful.

Shrestha BR and Gautam B[19] compared both ultrasound and landmark techniques in an ICU setup with 120 patients and analyzed the outcomes. An average of 1.5 attempts and less time (4.9±1.7 minutes) was needed with ultrasound when compared to an average of 2 attempts and more time (8±2.8 minutes) with landmarks technique. A failure rate of 12% was noted with landmark technique which required ultrasound rescue intervention. They demonstrated that ultrasound technique can be used as an intervention in failed cannulations.

Mallory et al[20]assigned patients randomely into two groups- conventional and 2D ultrasound guided internal jugular vein cannulation. They inferred from their study that 2D ultrasound

visualization of the vein during cannulation can reduce the failure rate of internal jugular vein cannulationfrom 35% to 0%. They construe that ultrasound should be considered in difficult situations and those with increased risk of complications.

Hatfield et al[21] determined the usefulness in applying ultrasound in difficult or failed central venous cannulations when compared with conventional methods. He concluded the reasons were due to anatomical variations, small size vessel, collapsing vein or may be due to presence of a thrombus. Thus advocates the use of ultrasound in all central venous cannulations though the authors realize it cannot be used as a substitute or replace the use of traditional methods

Gopal el at [22]studied the effects of ultrasound on central venous catheterizations and compared with anatomical landmark technique in an ICU setup in 450 patients requiring CVCs. He noted that ultrasound reduces the time taken to cannulate the vein with lesser incidence of complications.

John G.Augoustides et al[35] conducted a clinical trial in a large university anesthesia department and recruited 434 patients. They concluded that needle guided ultrasound cumulative cannulation is 100% by seventh needle pass. Ultrasound helps in prompt cannulation in a novice operator.

Zhang et al[33] explored the application of ultrasound in locating the internal jugular vein and its relation to common carotid artery for IJV catheterizations in 150 patients. They divided the patients into three groups- anatomical landmarks, ultrasound surface positioning and ultrasound- guided. They rated success of first puncture attempt in78.0% and 80.0% in ultrasound positioning and ultrasound guided respectively which was higher than anatomical landmark(22.0%). So they concluded ultrasound identify the diameter, its course and any abnormalities. Therefore ultrasound can be used as a support technique for IJV cannulation as a clinical application.

Salma M et al[32] attempted to determine if ultrasound helps operators to improve internal jugular vein cannulation success rate in an ICU. They suggested use of ultrasound guidance when IJV is not cannulated 3 minute by external landmark technique.

Erkki M. Koski et al [34]compared conventional technique with ultrasound aided technique and reported that ultrasound reduces the time taken (35 +/- 19 vs 198+/- 211 seconds) and number of attempts (1.2 +/- 0.5 vs 3.3+/- 3.0).

MATERIALS AND METHODS

4 Materials and Methods

A study entitled "**A comparative study of right and left IJV cannulation using surface anatomy or USG guidance**" was undertaken in PSG Institute of Medical Sciences and Research, Coimbatore after obtaining clearance from the Institutional Human Ethics Committee on January 2014. The study was conducted during the period of January 2014 to August 2014. A written informed consent was obtained from all the patients and family members.

Sample size was calculated with the formula below and 26 samples in each groupwere calculated.

SAMPLE SIZE DETERMINATION

$$n=\frac{2\times SD^2\times\left(\frac{Z_1-\alpha}{2}+\frac{Z_1-\beta}{2}\right)^2}{(M_1-M_2)^2}$$

$$n=\frac{2\times(142)^2\times(1.96+0.84)^2}{109^2}=26$$

Where n- sample size in each group

$\frac{Z_{1-\alpha}}{2}$- 1.96

$\frac{Z_{1-\beta}}{2}$ – 0.84

SD- standard deviation of the study group obtained from previous study done by Sulek et al[14].

106 patients from all critical care areas and those patients scheduled for elective cardiothoracic, vascular, neurosurgeries and major abdominal surgeries, requiring central venous cannulations and belonging to ASA Class I, II and III, were included in the study. The patients' age was varying between 18 - 80 years.

4.2 Inclusion criteria

- Adults- age group- 18-80 years
- Awake spontaneous breathing
- Mechanical ventilated / anesthetized
- American Society of anesthesiologists physical status grading 1,2,3

- Males and females

4.3 Exclusion criteria

- Patient refusal
- Previous history of neck dissection, burns, bleeding and coagulation disorders, and radiation therapy
- Emergency surgeries and medical conditions
- Previous cannulations
- Infections and mass over the site
- External anatomical abnormality

The study population was randomly divided into 4 groups with 26 patients in each group by using a computer generated randomization table number.

Group 1	right internal jugular vein cannulation by surface anatomy
Group2	right internal jugular vein cannulation by ultrasound guidance
Group 3	left internal jugular vein cannulation by surface anatomy
Group 4	left internal jugular vein cannulation by ultrasound guidance

Table 1- Study population divided into 4 groups

All cannulations were done by the principal investigator who was familiar in internal jugular cannulations by surface anatomy and in application of ultrasound in internal jugular cannulations. All the data collected was recorded by an assistant.

Current practice guidelines on central venous access suggested by the ASA Task Force suggest recommendations. These guidelines suggest use of assistants during internal jugular vein cannulation, use of real time ultrasound guidance and methods to verify correct placement of internal jugular vein cannulation[(23).]

The procedure was done in a sterile environment with an assistant present throughout the procedure. All the patients were placed in 30^{o} Trendelenburg position with the head rotated about 45^{o} opposite to side chosen for cannulation. Following all sterile precautions the side chosen was sterilized with povidine iodine and then with chlorhexidine as per institution protocol. The side chosen was then draped with the required area exposed. All cannulations were done bySeldinger's technique i.e. catheter over guidewire first described by Dr. Sven IvarSeldinger, a Swedish radiographer[24].

A sterile standard set specific for internal jugular cannulation was only used. After insertion, the catheter was fixed on the skin with sterile sutures. A transparent sterile bio-occlusive dressing was applied over the insertion site (Tegaderm). A sterile label was placed to record date of insertion. A complication, if arisen, was managed after assessment by anesthesiology faculty members.Position of catheter tip was confirmed chest X-ray film post procedure.

4.4 IJV cannulation by surface anatomy

The area was identified by presence of the two heads of sternocleidomastoid muscle and clavicle with carotid pulsations palpated at the apex of this triangle. A 24 gauge needle was used for giving local anesthesia at that site of puncture. A similar 24 gauge needle was then used as a locator needle to identify the internal jugular vein by colour of the blood. Once back flow of venous blood is obtained, this needle then guides a 16 gauge needle with syringe containing heparinsed saline to locate the internal jugular vein.

Once again back flow of blood is aspirated through the 16 gauge needle to confirm internal jugular vein puncture by its dark colour and non- pulsatile nature. Through the 16 gauge needle a J-tipped guide wire is inserted. The needle is removed, and a dilator is then used over the guidewire to dilate the puncture for insertion of the triple lumen catheter (Centrofix® B. Braun Melsungen AG, Germany).

In the event when vein was not located by more than six attemptswith the locator needle or in any event where there is difficulty in passage of guidewire insertion, IJV was cannulated by using USG guidance. An attempt was defined as skin puncture with locater needle to successful insertion of guidewire.

4.5 IJV cannulation by ultrasound guidance

A7.5 MHZ ultrasound transducer probe (Vivid-*i*) covered in sterile plastic sheath connected to a real-time USG machine was used. The internal jugular vein and the carotid artery were then identified by pulsations, by probe compressibility and by Doppler colour flows. The common carotid artery is identified as an anechoic area that is pulsatile and non- compressible with the ultrasound transducer probe. The shape of the artery is seen circular in a cross-sectional view. The internal jugular vein similarly seen as an anechoic area but it is non- pulsatile and compressible. The shape of the vein may be seen ovoid or ellipsoid in a cross sectional view.

A16 gauge needle with syringe containing heparinized saline was used to insert into the IJV under direct real time ultrasound guidance in short axis view. Aspiration of blood is done to confirm location by colour, after which a J-tip guide wire was inserted. The position of the wire in the vein lumen was confirmed by ultrasound by long axis view and in short axis view. This was followed by a dilator and then the triple lumen catheter (Centrofix® B. Braun Melsungen AG, Germany) was finally inserted.

If placement of the J-tipped wire was unsuccessful, the opposite side vein was used for cannulation under ultrasound guidance.

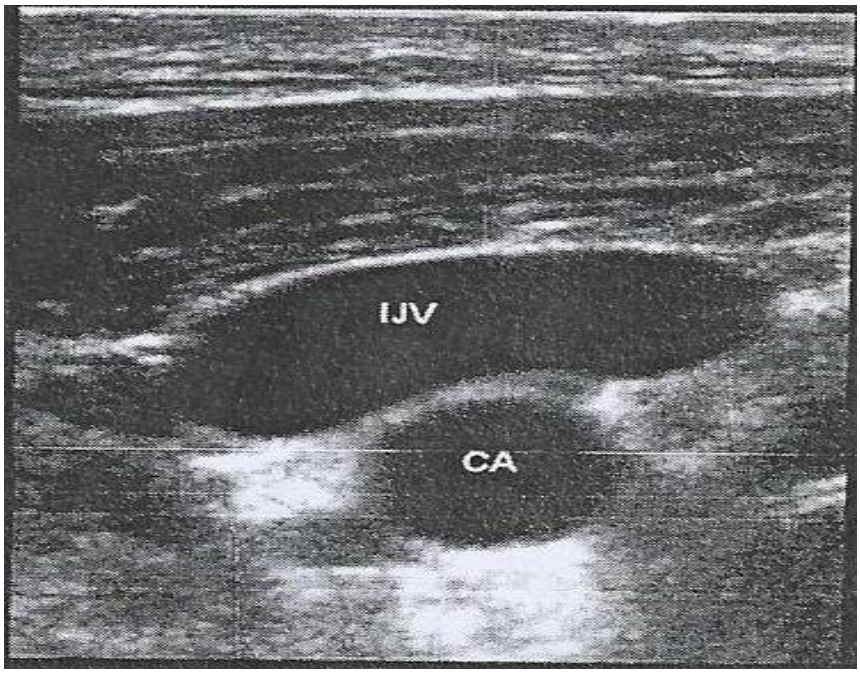


Fig. 14 - Ultrasound image in short axis view showing right internal jugular vein completely overlapping the right carotid artery from the data collected

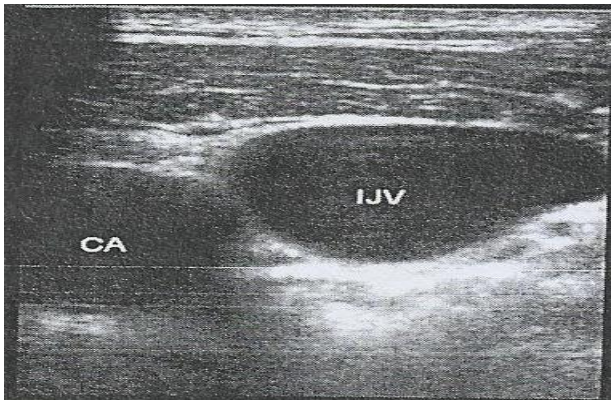


Fig. 15 - Ultrasound image showing anterolateral relationship of right internal jugular vein with right common carotid artery from the data collected

We considered the endpoint of the study when successful cannulation of the internal jugular vein is present.

The number of attempts and total time taken were noted for each cannulation of the internal jugular vein. The time from initial skin puncture to proper placement of the guidewire into the vein was recorded using a stopwatch. The position of the cannula was confirmed by–

- long axis viewof the catheter within the vein using ultrasound
- the colour of the blood aspirated and
- the non- pulsatile nature

Post- procedure chest X-ray films were taken. The following data was collected –:

- successful cannulation
- time taken from from initial skin puncture to successful guidewire placement
- number of attempts in each group

- incidence of complication in each group
- number of cross- over of technique

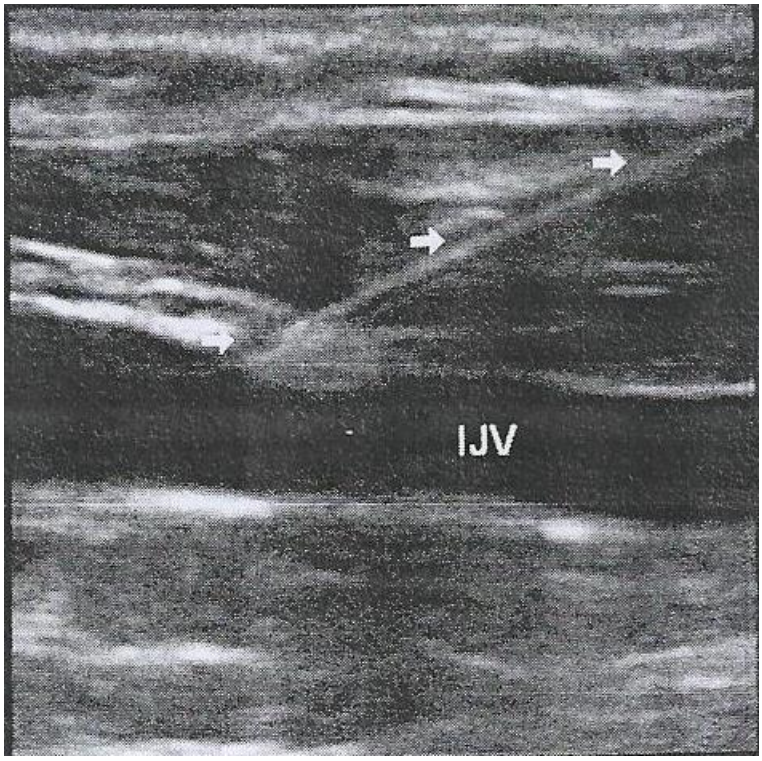


Fig. 16 - Ultrasound image showing long axis view of needle puncturing the internal jugular vein from the data collected

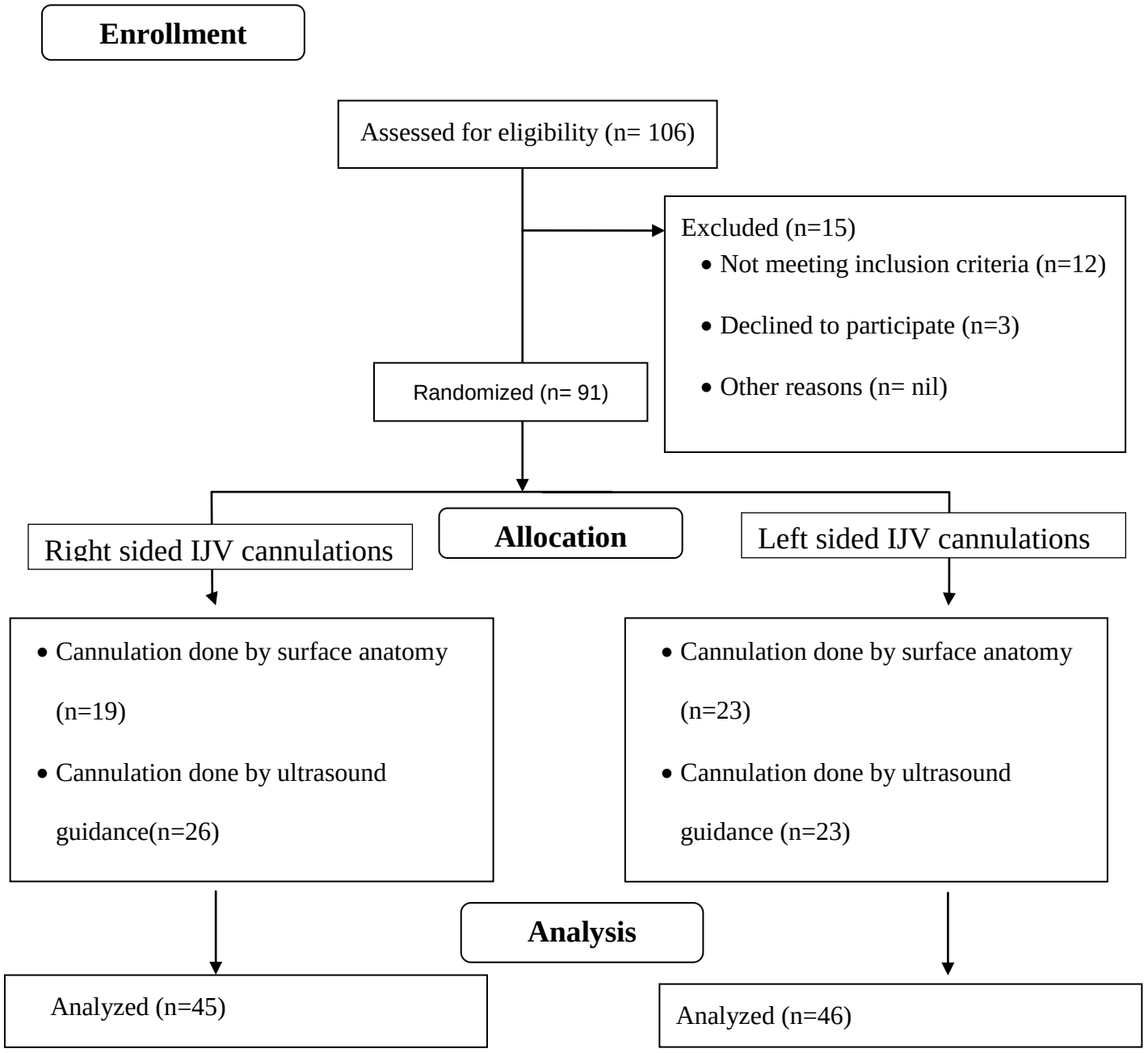
When there was more than six attempts or any complication during the procedure using surface anatomy, there was cross-over of technique to using ultrasound.

4.6 Statistical analysis of the data collected

The data collected was entered in Microsoft Excel Worksheet and analyzed using STATA statistical software package release version 19.0. In our study, continuous variables were analyzed using independent sample T-test and categorical variables were analyzed using chi- square test. Simple calculations like percentages, averages and mean was derived. A type 1 error of 0.05 was considered during analysis.

Results

6.1. CONSORT 2010 Flow Diagram



6.2. Results

106 patients were selected, of which after exclusion, 91 patients were analyzed.

Table 2- Age distribution in each group

Age in years	Group 1		Group 2		Group 3		Group 4	
	No. of patients	%	No. of patients	%	No. of patients	%	No. of patients	%
18-30	1	5.3	2	7.7			1	4.3
31-40	2	10.5	1	3.8	5	21.7		
41-50	5	26.3	4	15.4	8	34.8	3	13.0
51- 60	6	31.6	7	26.9	6	26.1	11	47.8
61-70	5	26.3	9	34.6	4	17.4	7	30.4
71- 80			3	11.5			1	4.3
Mean age in years ± SD	51.42±12.04		56.88±13.05		49.82±10.24		56.56±10.07	

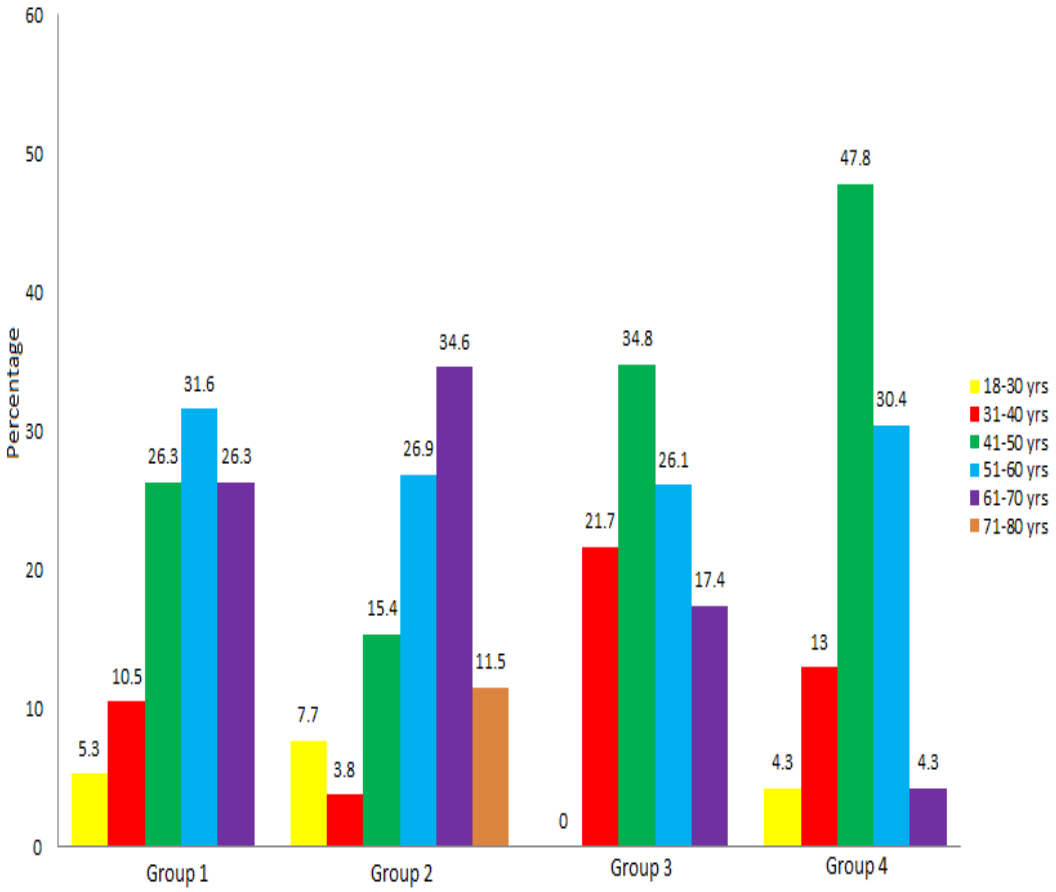


Fig. 17 - Frequency distribution of age in each group

This table 2 and figure 17 shows that the distribution of mean age in each group. The mean age in years in group 1, group 2, group 3 and group 4 were 51.42±12.04, 56.88±13.05, 49.82±10.24, and 56.56±10.07respectively. There was no statically significant difference between the groups (p value >0.05). All groups were found be similar with respect to age distribution.

Table 3- Gender distributionin each group

	Group	Frequency	Percentage
1	Female	5	26.3
	Male	14	73.7
	Total	19	100.0
2	Female	7	26.9
	Male	19	73.1
	Total	26	100.0
3	Female	6	26.1
	Male	17	73.9
	Total	23	100.0
4	Female	6	26.1
	Male	17	73.9
	Total	23	100.0

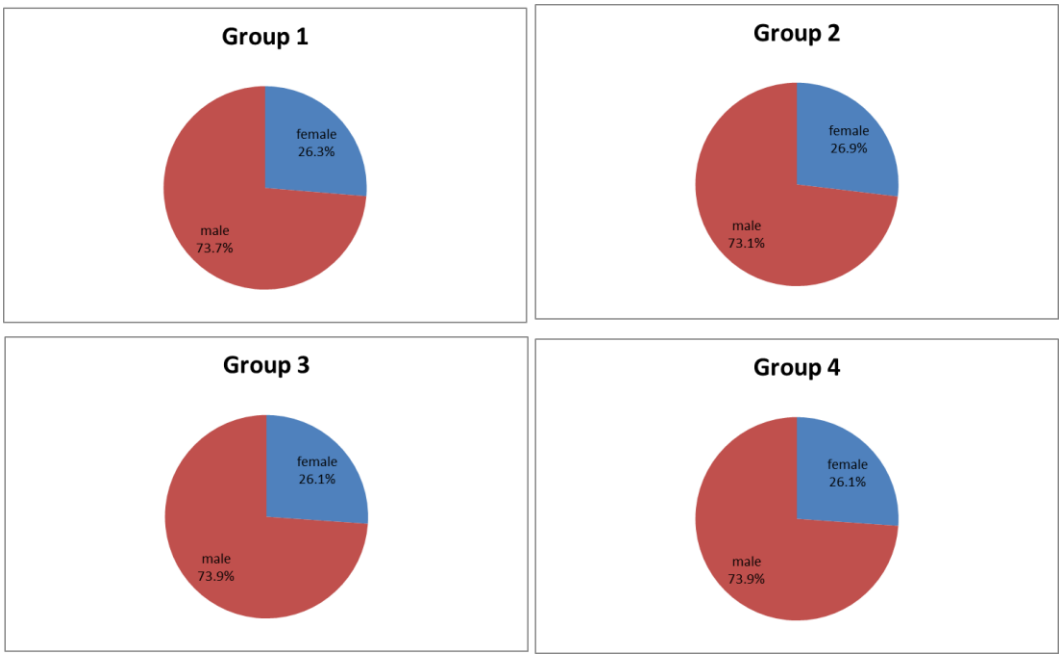


Fig. 18 - Pie charts showing gender frequency distribution among each group

Table 4-Average Time taken for cannulation measured in seconds in all four groups

Group	No of attempts	Minimum	Maximum	Mean	Std. Deviation
1	19	35.00	910.00	172.45	213.60
2	26	25.00	600.00	136.47	122.86
3	23	81.60	470.00	273.87	127.59
4	23	35.00	392.00	135.25	105.09

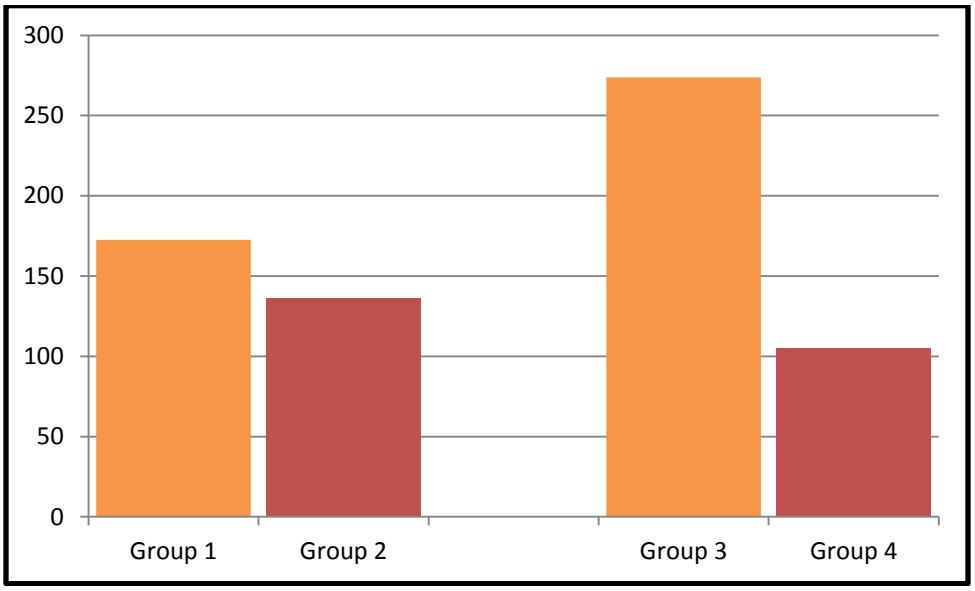


Fig. 19 –Average mean time in seconds in each group

The table 4 and figure 19 shows that the average time taken in each group. The minimum time taken in group 1, group 2, group 3 and group 4 were 35 seconds, 25 seconds, 81 seconds, and 35 seconds respectively. The maximum time taken in group 1, group 2, group 3 and group 4 were 910 seconds, 600 seconds, 470 seconds and 392 seconds, respectively. The average time taken in group 1, group 2, group 3 and group 4 were 172.45±213.60, 136.47±122.86 seconds, 273.87±127.59 seconds, and 135.25±105.09 seconds respectively. There was not statistically significancebetween Group 1 and Group 2 (p value 0.479). Also there was no statistically significance between Group 2 and Group 4(p value 0.970). There was a statistically significant difference (p value <0.001) between Group 3 and Group 4.

Table 6- Number of attempts in each group

Attempts	Group 1		Group 2		Group 3		Group 4	
	No. patients	%	No. patients	%	No. patients	%	No. patients	%
1	9	47.4	16	61.5	6	26.1	13	56.5
2	3	15.8	8	30.8	3	13.0	4	17.4
3	5	26.3	2	7.7	7	30.4	6	26.1
4	1	5.3	-	-	5	21.7	-	-
5	1	5.3	-	-	1	4.3	-	-
6	-	-	-	-	1	4.3	-	-
Mean± SD	2.05± 1.22		1.46± 0.64		2.78±1.41		1.69±0.18	

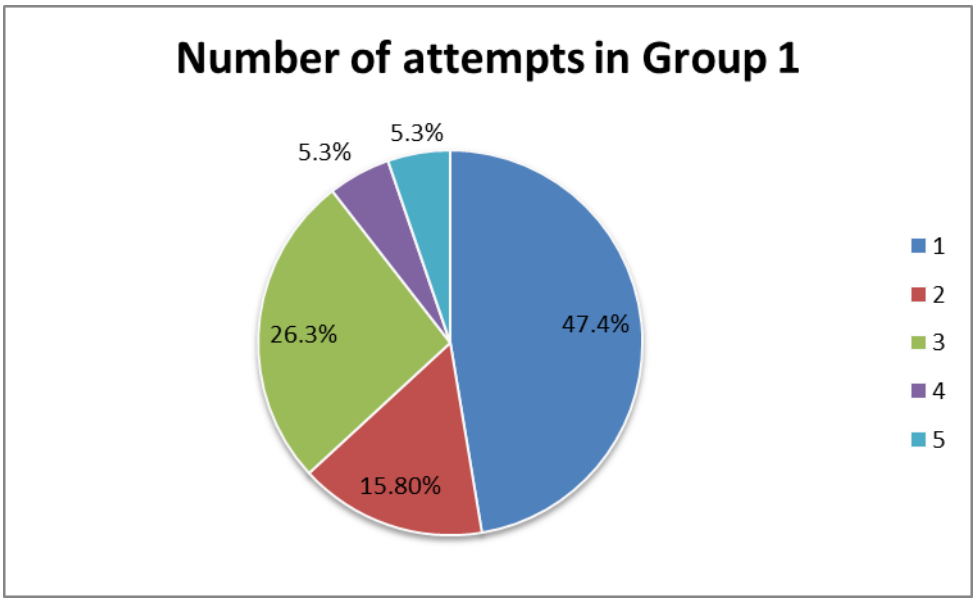


Fig. 20- Number of attempts in Group 1

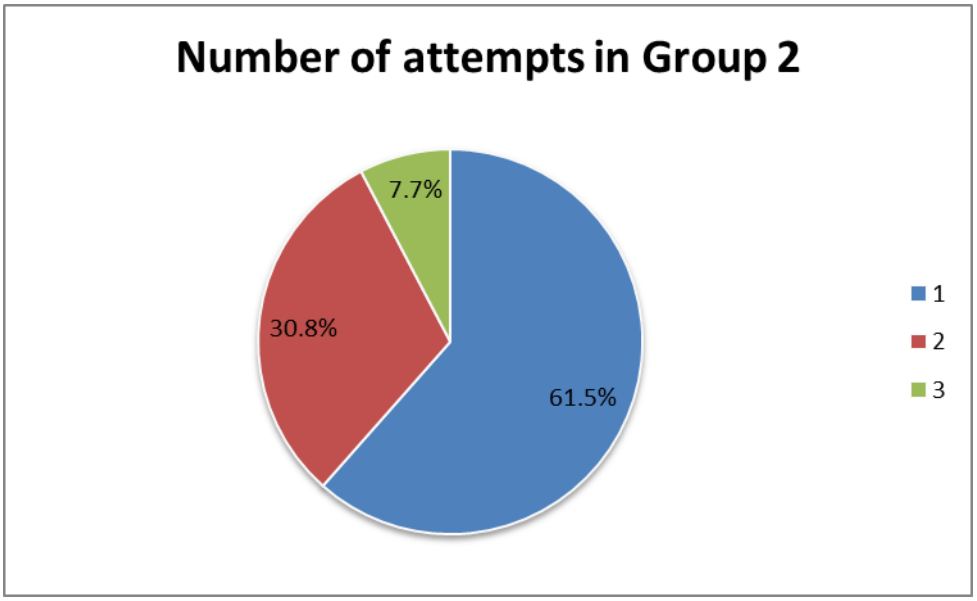


Fig. 21- Number of attempts in Group 2

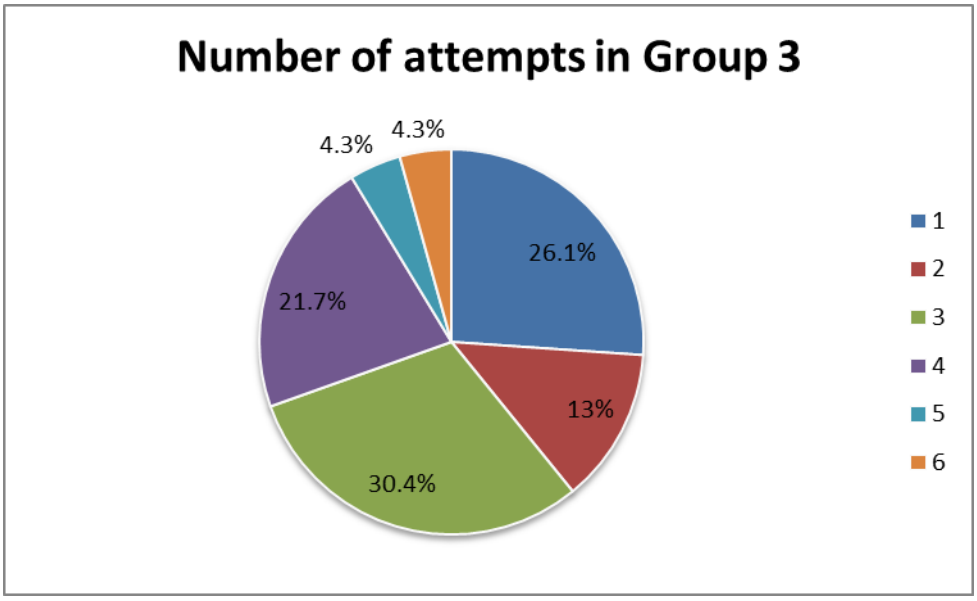


Fig. 22- Number of attempts in Group 3

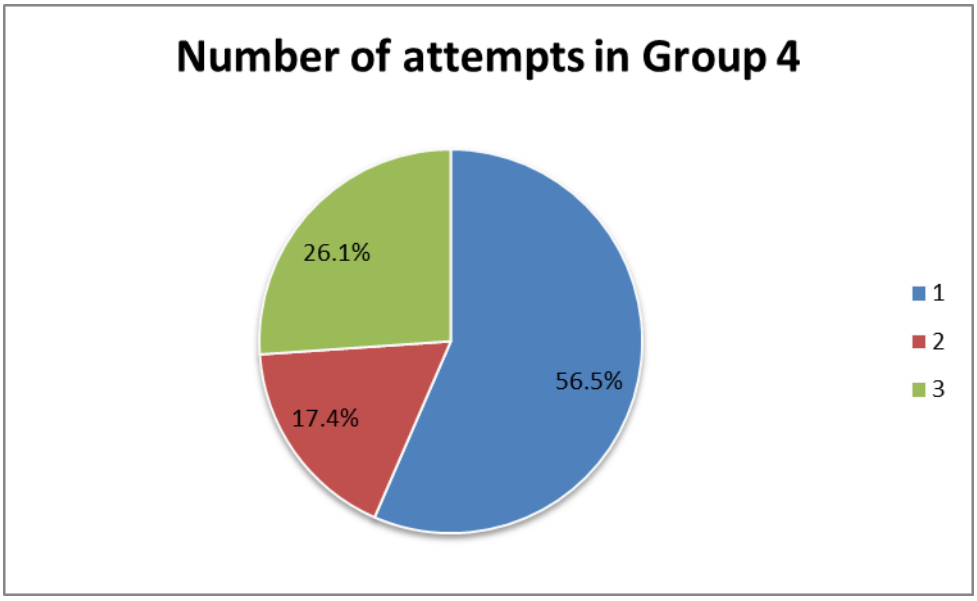


Fig. 23- Number of attempts in Group 4

The table 6 and figures 20- 23shows the average attempts taken in each group. The average attempts in group 1, group 2, group 3 and group 4 were 2.05±1.22,1.46± 0.64, 2.78±1.41, and 1.69±0.18respectively. There was a difference in number of attemptsbetween Group 1 and Group 2 that was statistically significant (p value <0.05).Also there was statistically significance (p value <0.01) between Group 3 and Group 4. But there was no statistically significance between Group 2 and Group 4(p value-0.289).

Table 7- Incidence of Complications in each group

Group	No. of carotid punctures	Percentage
1	1	5.3%
2	0	0
3	8	34.8%
4	0	0

The number of complications in each group was noted. Complications such as carotid puncture, hematoma, pneumothorax and others were noted in each group. Among all the known complications only carotid punctures were noted in this study. The table 7 shows the incidence of complications in each group. Statistic evaluation of the incidences of carotid puncture shows no statistically significance between Group 1 and Group 2 (p value- 0.247) but there was significance between Group 3 and Group 4(p value <0.01)

Table 8- Number of patients requiring crossover of technique

Group	No. of patients requiring crossover	Percentage
1	1	5.3%
2	0	0
3	8	34.8%
4	0	0

The table 8 shows the number of patients requiring cross over in each group. Statistic evaluation of the incidences of carotid puncture shows no statistically significance between Group 1 and Group 2 (p value- 0.247) but there was significance between Group 3 and Group 4(p value <0.01). All patients were interventions was required was analyzed and a 9.9% failure rate was noted. This was found to be statistically significant among all groups (p value< 0.001).

DISSCUSION

5 Discussion

Central venous cannulations are world-wide done procedures in every hospital especially for critically ill patients and for all indicated patients. Unfortunately, this procedure has been associated with major risks and complications. In the past it was done by direct cannulation of vein with a large bore metal needle. Later with the introduction of Seldinger's technique, the risks were reduced by the simple method of using a locating needle followed by the internal jugular cannulation [(24)]. As anesthesia has been associated with risks, attempts are being made to give safe anesthesia care.

Since the introduction of handy portable bedside ultrasound imaging devices, the scope of ultrasound uses has expanded from diagnostic to therapeutic purposes. Ultrasound is now used by anesthesiologists for guiding procedures[(25)].With increasing availability of miniature ultrasound units, has led to preference for

ultrasound aided internal jugular cannulations among novices at the start of their training [28].

As described in previous studies, ultrasound aided real time guidance helps in shortening the duration of internal jugular cannulation. The average time taken in each group were statistically different (using USG aided right IJV average mean time- 172.45±213.60 sec and left IJV average mean time- 273.87±127.59 sec).Also noted with ultrasonographically guided internal jugular vein catheterization, lesser attempts wereneeded that was consistentto earlier studies(right IJV requiring 1.46±0.64 and left IJV requiring 1.69±0.18).

Our study shows that left-sided IJV cannulations took a longer time with as many attempts to cannulate the left internal jugular vein (Group 3–273.87±127.9 sec versus Group 4–273.87±127.59 sec and Group 3 –2.78±1.41attempts versus Group 4 – 1.69±0.18 attempts).The reason noted to be due to the shape of its anatomical course.

For internal jugular cannulations, the anatomical course of internal jugular vein and its relations is very important for an anesthesiologist. Its uses, indications and contraindications should be known prior to cannulations for maximum benefit to patients[26].

We have noted in our study that during cannulation of the left internal jugular vein, negotiation of the guidewire into the left internal jugular vein was more difficult than right internal jugular vein.

This difficulty in negotiation of guidewire is due to the differences in anatomy of bilateral internal jugular veins. The right internal jugular vein has a straighter course and more dilated when compare to the left internal jugular vein. The differences are present owing to the fact that the right internal jugular vein has a preferentially dominant drainage of the head and the course of the left internal jugular vein is torturous. When cannulating the left internal jugular vein the operators have to negotiate- 1) the junction of the left internal jugular vein with the left subclavian vein and 2) the junction

of the left innominate vein with superior vena cava. In most individuals the veins of the head drain preferentially into the right jugular vein so therefore more dilated than the leftinternal jugular vein[14].Hence many anesthesiologists prefer to cannulate the right internal jugular vein over the left internal jugular vein.

Artery puncture of the common carotid artery is the most encountered complication apart from other complications. Imaging studies have shown this complication to be due to the close proximity of the carotid artery to the internal jugular vein. Other complications are pneumothorax, hemothorax, nerve injuries, hematomas, thrombosis, etc. In our study we noted a 5.3% carotid puncture in right IJV cannulation and a 34.8% carotid puncture in left IJV cannulation under external surface landmarks unlike under ultrasound guidance were there were negligible complications.

In our study, we noted that in the group where internal vein cannulation done surface anatomy, a total of 9 patients needed crossover rescue with ultrasound. This is due to carotid punctures.

Fig. 24- Chest X-ray film showing malposition of the left internal jugular venous catheter into right subclavian from the data collected

Fig. 25- Chest X-ray film showing malposition of left internal jugular catheter into right internal jugular vein from the data collected

We have also noted during our study that the catheter tip tends to misplace when the left internal jugular vein was cannulated. The catheter tip may either lie within the brachiocephalic vein or within right or left subclavian vein. The catheter tip may also misplace into the contralateral internal jugular vein as seen in our study (figure 25).This poses a problem when central venous pressures are needed for hemodynamic monitoring and in fluid management.

A study done by Macken et al [(10)] shows that the normal internal jugular vein commonly lays anterolateral to the common carotid artery at the level of the cricoid cartilage. But studies have also shown that the right internal jugular veinlies in the lateral position to the common carotid artery in 3.3% individuals. When the right internal jugular vein is compared to left internal jugular vein, the left internal jugular vein was found to be in anteromedial segment in relation to the common carotid artery. Moreover this position of left internal jugular vein may change to anterior or anterolateral with

rotation of the head. They also noted atypical positions such as posterior and medial are present in some individuals [10].

For improving visualization of the internal jugular vein in internal jugular venous cannulations certain adjustments can help in better access.

- Trendelenburg position can help in dilatation of the internal jugular vein due to increased venous return of blood.
- A small cushion placed below the shoulders can increase neck flexion and head extensionespecially those with short neck.
- Proper strict aseptic precautions could reduce catheter related line infections.
- Adequate local skin infiltration with local analgesics adds some comfort to the patient and also better compliance.
- Use of a locator needle identifies the vein without traumatizing the nearby artery.
- Use of real time imaging can aid placement of catheters.

Limitations of the study

Among the 106 patients, 15 patients were excluded by the criteria. This has led to unequal distribution of patients between groups.

This study was done in a limited time frame. If more number of patients were recruited, the statistical analysis and results of our study would be altered.

SUMMARY

6 Summary

This study was done to compare the success rate of internal jugular cannulations and to determine the average time duration taken to cannulate the right and left internal jugular vein using surface anatomy and ultrasound. The number of attempts and incidence of complications in each group were compared. The study was undertaken in PSG Institute of Medical Sciences & Research, Coimbatore during the period of January 2014 to August 2014.

The success rate was significant comparable in right sided internal jugular vein cannulations using ultrasound when compared (p value <0.01) to using surface anatomy. Similarly, the success rate was significantly comparable (p value < 0.01) in left sided internal jugular vein cannulations using ultrasound when compared to using surface landmarks.

The time taken for right internal jugular vein cannulations using ultrasound wasnot significant when compared to

using surface anatomy. Whereas, the time taken for cannulating left internal jugular vein with ultrasound aid was significant when compared to surface anatomy. There was no statistic significant difference between right and left internal jugular cannulation done by ultrasound guidance.

The number of attempts was statistically significantly higher in right internal jugular veinultrasound guidance than using surface anatomy. Similarly, the number of attempts in left internal jugular vein cannulations using ultrasound was statistically higher than with surface anatomy. There was no significant difference between right and left ultrasound guided internal jugular cannulations

The incidence of carotid puncture was not statistically significant between right internal jugular vein cannulation using surface landmarks and ultrasound guidance. The incidence of carotid punctures was noticed be statistically significantly higher in left internal jugular vein cannulations using surface landmark techniquethan using ultrasound guidance.

CONCLUSION

7 Conclusion

Ultrasound helps in safer successful cannulation of the internal jugular vein with lesser incidence of complications of carotid punctures especially for left sided internal jugular vein cannulations. Moreover, ultrasound guided internal jugular vein cannulation helps in reducing the average time duration.

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ANNEXURES

PSG Institute of Medical Science and Research, Coimbatore

Institutional Human Ethics Committee

INFORMED CONSENT FORMAT FOR RESEARCH PROJECTS

(strike off items that are not applicable)

I / ~~We~~ (write name of the investigator(s) here), Dr. Anitha Sunny am / ~~are~~ carrying out a study on the topic: **A comparative study of right and left IJV cannulation using surface anatomy or USG guidance**as part of my / our research project being carried out under the aegis of the Department of: **Anesthesiology**

(*Applicable to students only*): My / ~~our~~ research guide is: Dr. C Ganesan

The justification for this study is:

USG guided approach is a more safe and advanced technique that is preferable in an ICU setups

The objectives of this study are:

Primary Objective:

- To compare the success rate by right and left internal jugular venous cannulation by using surface anatomy or ultrasonography guidance
- To compare the time taken by right and left internal jugular venous cannulation by using surface anatomy or ultrasonography guidance

Secondary Objective:

- To compare the number of attempts for the right and left internal jugular cannulations by using surface anatomy or ultrasound guidance
- To compare the incidence of complications in right and left internal jugular cannulations by using surface anatomy or ultrasound guidance

Sample size: 100 .

Study volunteers / participants are (specify population group & age group): From ICU and post operative ICUs, 18-80 years.

Location: PSG IMS&R.

We request you to kindly cooperate with us in this study. We propose collect background information and other relevant details related to this study. We will be carrying out:

Initial interview (specify approximate duration): 15 minutes.

Data collected will be stored for a period of 2 years. We ~~wil~~l / will not use the data as part of another study.

Health education sessions: Number of sessions: _____. Approximate **duration** of each session: _____ minutes. **NA**

Clinical examination (Specify details and purpose): Examination of neck for visibility of veins and during procedure

Blood sample collection: Specify quantity of blood being drawn: _____ml. **NA**

No. of times it will be collected: _____. **NA**

Whether blood sample collection is part of routine procedure or for research (study) purpose: **NA** 1. Routine procedure 2. Research purpose

Specify **purpose**, discomfort likely to be felt and side effects, if any: _____**NA**

Whether blood sample collected will be stored after study period: Yes / No, it will be destroyed **NA**

Whether blood sample collected will be sold: Yes / No **NA**

Whether blood sample collected will be shared with persons from another institution: Yes / No **NA**

Medication given, if any, duration, side effects, purpose, benefits: **NA**

Whether medication given is part of routine procedure: Yes / No (If not, state reasons for giving this medication) **NA**

Whether alternatives are available for medication given: Yes / No (If not, state reasons for giving this particular medication) **NA**

Final interview (specify approximate duration): **NA** mts. If **photograph** is taken, purpose: **NA**

Benefits from this study: Subsequent patients will be treated by most superior method

Risks involved by participating in this study: Nil

How the **results** will be used: Only for study purpose

If you are uncomfortable in answering any of our questions during the course of the interview / biological sample collection, **you have the right to withdraw from the interview / study at anytime.** You have the freedom to withdraw from the study at any point of time. Kindly be assured that your refusal to participate or withdrawal at any stage, if you so decide, will not result in any form of compromise or discrimination in the services offered nor would it attract any penalty. You will continue to have access to the regular services offered to a patient. You will **NOT** be paid any remuneration for the time you spend with us for this interview / study. The information provided by you will be kept in strict confidence. Under no circumstances shall we reveal the identity of the respondent or their families to anyone. The information that we collect shall be used for approved research purposes only. You will be informed about any significant new findings - including adverse events, if any, – whether directly related to you or to other participants of this study, developed during the course of this research which may relate to your willingness to continue participation.

Consent: The above information regarding the study, has been read by me/ read to me, and has been explained to me by the investigator/s. Having understood the same, I hereby give my consent to them to interview me. I am affixing my

signature / left thumb impression to indicate my consent and willingness to participate in this study (i.e., willingly abide by the project requirements).

Signature / Left thumb impression of the Study Volunteer / Legal Representative:

Name and relation of the person signing on Study Volunteer his/ her behalf, if Study Volunteer unable to sign:

Signature of the Interviewer with date: Witness:

Contact number of PI: 9489832598

Contact number of Ethics Committee Office: 0422 2570170 Extn.: 5818

ஒப்புதல் படிவம்

அனிதாசன்னிஆகியநான் PSGமருத்துவக்கல்லூரியின் மயக்கமருந்தியல் துறையின் கீழ் A comparative study of right and left Internal Jugular Vein cannulation using surface anatomy or Ultrasonographic guidanceஎன்றதலைப்பின்கீழ் ஆய்வுமேற்கொள்ளஉள்ளேன்.

என் ஆய்வுவழிகாட்டி : டாக்டர்.C.கணேசன்

ஆய்வுமேற்கொள்வதற்கானஅடிப்படை :

ஆல்ட்ராசவுண்ட் கருவிபயன்படுத்திஅல்லதுபயன்படுத்தாமல் Internal Jugular Veinகேனுலேஷன் பொருத்துவதில் எதுசிறந்ததுஎன்பதற்கானஆய்வு.

ஆய்வின் நோக்கம்

எந்தசெயல்முறைசிறந்தது,நேரச்சிக்கனம் கொண்டது,முயற்சிஎண்ணிக்கைகுறைந்தது. பின்விளைவுகள் குறைவாகஉள்ளது.

ஆய்வுமேற்கொள்ளும் இடம் :

பி.எஸ்.ஜி. ஐ.எம்.எஸ்.ஆர்.

ஆய்வினபலன்கள்

இனிவரும் காலங்களில் இவை இரண்டில் சிறந்தமுறையைஅனைத்துநோயாளிகளுக்கும் பயன்படுத்துவதற்கு.

இந்தஆய்வில் கிடைக்கும் தகவல்கள் இரண்டுவருடங்கள்பாதுகாக்கப்படும். இவை வேறுஎந்தஆய்விற்கும் பயன்படுத்தப்படமாட்டாது. எந்தநிலையிலும் உங்களைப்பற்றியதகவல்கள் யாருக்கும் தெரிவிக்கப்படமாட்டாது. அவை இரகசியமாகவேவைக்கப்படும்.

இந்தஆய்வில்பங்கேற்கஒப்புக்கொள்வதால் உங்களுக்குஎந்தவிதமானபலனும் கிடைக்காது. எந்தநேரத்தில் வேண்டுமானாலும் ஆய்விலிருந்துவிலகிக்கொள்ளும் உரிமைஉங்களுக்குஉண்டு. ஆய்விலிருந்துவிலகிக்கொள்வதால் உங்களுக்குஅளிக்கப்படும் சிகிச்சையில் எந்தவிதமாற்றமும் இருக்காது.

இந்தஆராய்ச்சிக்காகஉங்களிடம் சிலகேள்விகள் கேட்டப்படும் சில இரத்தமாதிரிகள் அல்லதுதிசுமாதிரிகள் எடுக்கப்படும்.

மேலும் இந்தஆய்வில் பங்குகொள்வதுஉங்கள் சொந்தவிருப்பம். இதில் எந்தவிதகட்டாயமும் இல்லை. நீங்கள் விருப்பப்பட்டால், இந்தஆய்வின் முடிவுகள் உங்களுக்குத் தெரியப்படுத்தப்படும்.

ஆய்வாளரின் கையொப்பம் :

தேதி :

ஆய்வுக்குட்படுபவரின் ஒப்புதல்

நான் இந்தஆராயச்சியின் நோக்கம் மற்றும் அதன் பயன்பாட்டினைப்பற்றிதெளிவாகவும்,விளக்கமாகவும் தெரியப்படுத்தப்பட்டுள்ளேன். இந்தஆராய்ச்சியில் பங்குகொள்ளவும், இந்தஆராய்ச்சியின் மருத்துவரீதியானகுறிப்புகளைவரும்

காலத்திலும் உபயோகப்படுத்திக் கொள்ளவும் முழுமனதுடன் சம்மதிக்கிறேன்.

ஆய்வுக்குட்படுபவரின் பெயர்,முகவரி :

கையொப்பம் :

தேதி :

கையெழுத்துபோட இயலாதநோயாளிக்குபதில் கையெழுத்து இடும் நபரின் பெயர் மற்றும் உறவுமுறை

கையொப்பம் :

தேதி :

ஆய்வாளரின் தொலைபேசிஎண் : 9489832598

மனிதநெறிமுறைக்குழுவின் தொலைபேசிஎண். : 0422-2570170,Extn : 5818

Proforma

Patient's name

Age Group(in years)						
Gender	Male		Female			
Op number			Ip number			
Indication for IJV cannulation						
ASA grade	1		2		3	
Site chosen	Right		Left			
Technique	Surface anatomy		USG guided	Surface landmark converted to USG guided		
Number of attempts	1	2	3	4	5	>6
Time taken in seconds						
Patient conscious state	awake			anesthetized		
Complications	Carotid puncture		Pneumothorax/ hemothorax	hematoma	others	
Cannula in position	Yes			No		
Position of cannula if incorrect						
Relationship of IJV to Carotid artery						
Confirmed by Chest X-ray	Yes			No		
Cannulation Successful	Yes			No		
Reason for failure						
Patient compliance	Yes			No		

S. No.	Age(in years)	Gender	Ip no.	ASA grade	Group	Surgry/ medical conditions	co-morbid conditions	Cross- over technique	No. of attempts	awake(yes)/ anesthetized(no)	position	complications	Time(seconds)	compliance	Relationship of IJV to CA	Excluded(E)/Included(I)
1	69	F	14023323	3	1	CABG	CAD	nil	1	yes	yes	nil	43	no		I
2	52	M	14013720	2	1	CABG	CAD	nil	1	yes	yes	nil	127.83	no		I
3	55	M	14014537	3	1	CABG	CAD	nil	1	yes	yes	nil	55.9	no		I
4	59	M	14011270	2	1	CABG	CAD	nil	5	yes	yes	carotid puncture	330	no		I
5	47	M	14008380	3	1	CABG	CAD	nil	2	yes	yes	nil	298.4	no		I
6	62	M	14012284	3	1	MVR	smoker	nil	3	yes	yes	nil	150	no		I
7	54	M	14012748	3	1	CABG	CAD	nil	4	yes	yes	nil	477	no		I
8	51	M	14012457	3	1	CABG	CAD	nil	1	yes	yes	nil	40.7	yes		I
9	65	M	14013347	3	1	CABG	CAD	nil	1	yes	yes	nil	74	yes		I
10	20	F	14013393	1	1	Thorcotomy-Excision of pulmonary nodule		nil	2	yes	yes	nil	154	no		I
11	44	M	14069246	2	1	Oesophagectomy	Carcinoma oesophagus	nil	1	no	yes	nil	80	yes		I
12	42	F	14019819	3	1	Pnemonia	TB, HIV positive	nil	3	no	yes	nil	910	no		I
13	62	M	14019118	2	1	Anaphlactic Shock		nil	1	yes	yes	nil	35	no		I
14	69	M	14019349	2	1	left CVA		nil	1	no	yes	nil	45	yes		I
15	48	M	14022432	3	1	CABG	CAD,smoker	nil	1	yes	yes	nil	40	yes		I
16	54	M	14013200	3	1	CABG	CAD	nil	3	yes	yes	nil	103	no		I
17	40	M	14013201	3	1	CABG	CAD	nil	2	yes	yes	nil	121	no		I
18	38	F	14013398	3	1	ASD closure	DM	nil	3	no	yes	nil	136	no		I
19	46	F	14015981	3	1	CABG	CAD	nil	3	yes	yes	nil	55.9	no		I
20	63	M	14021950	3	2	CABG	CAD	nil	2	no	yes	nil	170	yes	Anterolateral	I
21	52	M	14022233	3	2	CABG	CAD	nil	1	no	yes	nil	137	yes	Lateral	I
22	62	M	14022253	3	2	CABG	CAD	nil	1	yes	yes	nil	39	yes	Lateral	I
23	26	F	14021932	3	2	Splenectomy		nil	1	yes	yes	nil	45	yes	Anterolateral	I
24	70	M	14022120	3	2	CABG	CAD	nil	1	yes	yes	nil	48	yes	Anterolateral	I
25	73	F	14021461	3	2	Laparotomy-obstructed hernia		nil	3	yes	yes	nil	250	yes	Anterior	I

26	28	F	14020445	2	2	Cardiogenic Shock, ACS		nil	1	no	yes	nil	25	yes	Anterolateral	I
27	57	M	14019843	2	2	acute pancreatitis, ARF		nil	3	yes	yes	nil	310.99	yes	Anterolateral	I
28	65	M	14021959	3	2	CABG+ AVR	CAD	nil	2	yes	yes	nil	180	yes	Lateral	I
29	72	M	14013049	3	2	Aspiration Pnemonia	DM, HTN, COPD, Obesity	nil	2	yes	yes	nil	600	yes	Anterolateral	I
30	75	M	14014849	3	2	CABG	CAD	nil	2	yes	yes	nil	60	yes	Anterolateral	I
31	33	M	14014538	3	2	CABG	CAD	nil	2	no	yes	nil	45	yes	Far lateral	I
32	59	M	14013981	3	2	urosepsis	DCLD, ARDS	nil	1	no	yes	nil	204.7	yes	Anterolateral	I
33	62	F	14012871	3	2	CABG	CAD	nil	1	yes	yes	nil	70	yes	Anterolateral	I
34	56	F	14034343	3	2	CABG	CAD	nil	1	no	yes	nil	60	yes	Anterior	I
35	65	M	14012847	3	2	CABG	CAD	nil	1	no	yes	nil	250	yes	Anterior	I
36	49	M	14008025	2	2	CABG	CAD	nil	1	yes	yes	nil	86	yes	Anterolateral	I
37	68	F	14008397	3	2	CABG+ AVR	CAD	nil	1	yes	yes	nil	48	yes	Anterolateral	I
38	60	M	14008149	3	2	CABG	CAD	nil	1	no	yes	nil	61	yes	Anterolateral	I
39	50	M	14003884	3	2	CABG	DM,CAD, Hypertension	nil	1	no	yes	nil	132.38	yes	Anterolateral	I
40	54	M	14009829	3	2	CABG	CAD	nil	1	yes	yes	nil	104	yes	Anterolateral	I
41	42	M	14021773	3	2	CABG	CAD	nil	2	no	yes	nil	110	yes	Anterior	I
42	60	M	14022465	3	2	CABG	CAD	nil	1	yes	yes	nil	172	yes	Anterolateral	I
43	63	F	14022671	3	2	CABG	CAD	nil	2	yes	yes	nil	40	yes	Anterolateral	I
44	66	M	14015067	3	2	CABG	CAD	nil	2	no	yes	nil	210.3	yes	Anterolateral	I
45	49	M	14016609	3	2	CABG	CAD	nil	1	no	yes	nil	90	yes	Anterior	I
46	45	F	14023320	3	3	CABG	CAD	nil	1	yes	yes	nil	83	no		I
47	54	M	14022859	3	3	CABG	CAD	nil	1	yes	yes	nil	150	yes		I
48	49	M	14018547	3	3	CABG	CAD	nil	1	yes	yes	nil	81.6	no		I
49	34	F	14014733	3	3	DVR		nil	2	yes	yes	nil	281.9	yes		I
50	38	F	14016790	3	3	Thrombectomy	CAD, DM	yes	4	yes	yes	carotid puncture	443	no		I
51	48	M	14011964	2	3	CABG	CAD	nil	2	yes	yes	nil	101.9	yes		I
52	61	M	14011494	3	3	CABG	CAD	nil	3	yes	yes	nil	440.7	no		I
53	68	F	14018969	3	3	CABG	CAD	nil	4	yes	no	nil	280	no		I
54	57	M	14023356	3	3	CABG	CAD	nil	4	yes	yes	nil	120	yes		I
55	35	F	14023479	3	3	AVR		nil	2	yes	yes	nil	270	no		I
56	48	M	14023722	2	3	Aortic Bifemoral Bypass	smoker	nil	1	yes	yes	nil	160	no		I
57	65	F	14023720	3	3	CABG	CAD	nil	3	yes	yes	nil	333.6	no		I

58	57	M	14023595	3	3	CABG+ AVR	CAD	nil	4	yes	yes	nil	330.6	no		I
59	45	M	14011926	3	3	CABG	CAD	nil	1	no	yes	nil	92.8	yes		I
60	55	M	14020283	3	3	Sepsis	DM, HCV positive, TB	nil	1	no	yes	nil	300	yes		I
61	55	M	14024557	3	3	CABG	CAD	nil	6	yes	yes	nil	350	no		I
62	58	M	14014251	3	3	CABG	CAD	yes	3	no	yes	carotid puncture	470	yes	Anterolateral	I
63	47	M	14018339	3	3	DCM	Schizophernia	yes	3	yes	yes	carotid puncture	300	no	Anterior	I
64	65	M	14020450	3	3	Cardiogenic Shock, ACS	DM, CVA, CKD, hypertension	yes	5	yes	yes	carotid puncture	395	no	Anterior	I
65	40	M	14020187	3	3	CABG	CAD	yes	4	no	no	carotid puncture	395	no	Lateral	I
66	42	M	14022593	3	3	CABG	CAD	yes	3	no	yes	carotid puncture	190	yes		I
67	48	M	14022165	3	3	CABG	CAD	yes	3	yes	yes	carotid puncture	430	no		I
68	32	M	14018973	2	3	DKA	DM	yes	3	no	yes	carotid puncture	300	yes	Anterior	I
69	80	M	14015610	2	4	nil	Parkinsonism, hypertension, Lefthemiparasis, right CVA, HCV positive	nil	1	yes	yes	nil	105	yes	Collapsing vein	I
70	51	M	14018846	3	4	CABG	CAD	nil	2	yes	yes	nil	220	yes	Lateral	I
71	70	M	14016349	2	4	right LL aortic femoral bypass and distal thrombectomy	smoker	nil	1	yes	yes	nil	80	yes	Anterior	I
72	48	M	14016393	3	4	CABG	CAD	nil	1	yes	yes	nil	76.6	yes	Anterior	I
73	63	M	14016967	3	4	AVR		nil	1	no	yes	nil	45	yes	Anterior	I
74	45	M	14016018	3	4	CABG	CAD	nil	1	yes	yes	nil	60.5	yes	Anterior	I
75	70	M	14014755	3	4	CABG	CAD	nil	1	no	yes	nil	35	yes	Lateral	I
76	45	F	14013471	3	4	MVR		nil	3	yes	yes	nil	106.7	yes	Anterior	I
77	56	M	14014672	3	4	CABG	CAD	nil	1	yes	yes	nil	59	yes	Anterior	I
78	55	M	14018993	3	4	Sepsis	renal failure and liver failure	nil	1	no	yes	nil	45	yes	Anterior	I
79	54	M	14019081	3	4	Metabolic encephalopathy	DM	nil	1	yes	yes	nil	70	yes	Anterior	I
80	62	M	14018975	3	4	CABG	CAD	nil	3	no	yes	nil	225	yes	Anterolateral	I
81	65	F	14019508	3	4	DVR	Hypertesion	nil	1	yes	yes	nil	78.88	yes	Anterolateral	I
82	30	F	14015063	3	4	MVR		nil	1	no	yes	nil	70	yes	Anterolateral	I

83	55	M	14015278	3	4	CABG	CAD	nil	2	yes	yes	nil	245	yes	Anterolateral	I
84	54	F	14012028	3	4	AVR	DM	nil	3	no	yes	nil	330	yes	Anterolateral	I
85	57	M	14019240	3	4	CABG	CAD	nil	3	yes	yes	nil	214	yes	Anterior	I
86	61	F	14018985	3	4	MVR	DM	nil	3	no	yes	nil	392	yes	Anterior	I
87	54	M	14020990	3	4	CABG	CAD	nil	1	no	yes	nil	78.09	yes	Anterolateral	I
88	53	M	14021832	3	4	CABG	CAD	nil	1	yes	yes	nil	76	yes	Anterior	I
89	63	M	14020821	3	4	CABG	CAD	nil	2	no	yes	nil	80	yes	Anterolateral	I
90	55	F	14021445	3	4	CABG	CAD	nil	3	no	yes	nil	326	yes	Anterior	I
91	55	M	14025985	3	4	CABG	CAD	nil	2	yes	yes	nil	93	yes	Anterior	I
92	47	F	14021225	2	1	seziure disorder										E
93	60	M	14021123	2	3	hemiplegia										E
94	39	M	14023212	3	4	Renal transplant										E
95	28	M	14020443	3	3	Cerebral malaria	HIV positive									E
96	80	M	14020394	3	4	sepsis	DM, HTN, CKD									E
97	64	M	14019722	2	1	ARDS	ILD									E
98	80	F	14018210	3	3	Hemodialysis	CKD									E
99	78	M	14020787	3	1	Hemodialysis	CKD									E
100	47	M	14019674	3	4	SBP	HCV, DCLD									E
101	56	M	14019518	3	1	Re do CABG	CAD, Post CABG status									E
102	60	F	14016097	3	1	Sepsis, ARDS	Post Whipples status									E
103	33	F	14018768	3	1	Cardiogenic shock	DM, HTN, CAD									E
104	80	M	14016612	3	1	Hemodialysis	CKD, CAD, DM									E
105	49	M	14020494	3	1	ARDS, sepsis	Post OPC posioning									E
106	63	M	14020134	3	1	recurrent hyponatremia										E